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TABLE OF CONTENTS.

Recipient of the Lamme Medal, 1928, George Fillmore Swain... 1
George Fillmore Swain 2
Liberalizing the Engineering Curriculum, Dexter S. Kimball, President of the Society..... 3
Robert Lemuel Sackett, President, 1927–28..... 7
The Changing Emphasis in Engineering Education. Presidential Address. R. L. Sackett..... 9
Discussion:
H. J. Hughes 16
C. C. Williams 20
A Study of Placement Examinations..... 25
Address of Welcome—The Significance of the Engineering Attitude in Modern Life. Harry Woodburn Chase..... 84
Response to Address of Welcome. R. L. Sackett..... 91
Report of the Secretary, F. L. Bishop..... 94
Report of the Treasurer, W. O. Wiley..... 106
The Summer School for Engineering Teachers, A Practical Step Toward Improving Methods of Teaching. H. P. Hammond..... 109
Discussion:
E. R. Maurer 122
LeRoy Tucker 124
T. F. Hickerson 126
W. J. Risley 127
A Conference on Engineering Mechanics in 1929. S. M. Woodward 131
The 1929 Session of the Summer School for Engineering Teachers. H. P. Hammond 132
Investigation of Non-College Technical Education. W. E. Wickenden 134
Minutes of the Council Meetings..... 137

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BENJAMIN GARVER LAMME

THE LAMME MEDAL

DR. GEORGE FILLMORE SWAIN OF HARVARD UNIVERSITY RECEIVES BENJAMIN G. LAMME MEDAL FOR ACCOMPLISHMENT IN TECHNICAL TEACHING *

The first award of the Benjamin G. Lamme gold medal "for accomplishment in technical teaching or actual advancement of the art of technical training" was made to Dr. George Fillmore Swain of Harvard, June 27, 1928.

Dr. Swain has attained distinction as a thorough and practical engineer, an inspiring teacher and an authoritative writer. He received his technical education at the Massachusetts Institute of Technology and the Royal Polytechnic School of Berlin. Honorary degrees have been granted to him by the New York University and the University of California.

In 1881 Dr. Swain started his teaching work at the Massachusetts Institute of Technology. Since 1909 he has been a distinguished member of the faculty of the Harvard Engineering School.

Dr. Swain has served as a Consulting Engineer for the Massachusetts Railroad Commission and has been associated with a number of engineering enterprises mainly in the field of transportation. His achievements have stood the test of time and his published works provide a means for extending his influence to the future.

The medal which has been awarded by the Society for the Promotion of Engineering Education was provided by the will of the late Benjamin G. Lamme, formerly Chief Engineer for the Westinghouse Electric & Manufacturing Company. It was Mr. Lamme's desire to advance the engineering profession by encouraging good technical teaching.

* Report of Committee on Lamme Award, presented at the 36th Annual Meeting of the Society, University of North Carolina, Chapel Hill, June 26–29, 1928.

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GEORGE FILLMORE SWAIN

BY W. E. MOTT AND MORRIS KNOWLES,

Former Students of Professor Swain.

The selection of Dr. George Fillmore Swain as the first recipient of the Lamme medal is a source of especial pride and gratification to that large group of men who have sat at the feet of this exceptional teacher. A distinguished engineer and public official, always giving his best in the interest of civic improvement and in the councils of his fellow engineers, Dr. Swain has made his greatest contribution to the cause of technical education. In his address as retiring president at the Ottawa meeting of the American Society of Civil Engineers—June, 1913—he said: "Our teachers are generally, I think, chosen upon an incorrect principle; they are appointed by reason of what they know; it seems to me they should be selected for what they are—for their ability to teach, and their power of enforcing scientific discipline." And he himself lived up to this principle. Even in those early days of his teaching career, fresh from his studies in Germany, he did not emphasize the content of his courses, mere information was relatively unimportant; but how he did insist on "enforcing scientific discipline"!

For the lazy or indifferent student this meant either reform or the end of his civil engineering course; for the others it constituted a training in methods of analysis and in mental discipline which was never forgotten. Dr. Swain is not the type of teacher who is constantly prodding his pupils; mental stimulation in his classes is ever present and a wealth of fundamental theory and illustration is always at the student's command; he is not unduly pushed but he must possess initiative and develop a power of independent thinking and reasoning or a crisis is imminent!

Always lavish with his own time and with abundant energy, Swain has trained a generation of engineers whose careers bear testimony to the soundness of his methods and constitute an "accomplishment in technical teaching or actual advancement of the art of technical training" which has few, if any, equals in American educational history.

LIBERALIZING THE ENGINEERING CURRICULUM

DEXTER S. KIMBALL,

President of the Society, 1928–29

The great majority of engineering teachers and practicing engineers are in agreement apparently with the idea that the engineering curriculum should be broadened and liberalized. As to just what new subject matter should be introduced into the curriculum for this purpose there is much diversity of opinion though Mr. Wickenden's report has done much to clarify that problem and any discussion of it is beyond the limits of this paper.

On the question as to how these and other liberalizing subjects are to be incorporated into the curriculum there are also great differences of opinion. The inherited viewpoint in this country is that all professional education grows out of, and is an extension of general training. Practically all of the experiments in liberalizing engineering education in this country have been built around this idea, the most usual plan being to interpose one or more years of general studies between the preparatory school and the professional work of the engineering college. Such an arrangement has, of course, the full sanction of those who believe in the miraculous powers of certain subjects. There is, of course, something to be said for this idea, but in the opinion of the writer it has grave defects. Space will permit only the briefest mention of some of these.

First, there has been, as yet, no well-thoughtout definition of an educational content that will be peculiarly liberalizing to the engineer either by the engineering colleges or by those who teach the liberal arts, so called, and who are most vociferous in advocating such measures. And remembering that the time of college men is limited and valuable, there is no place for wasted effort in the engineering curriculum. So far as

the writer is aware, no constructive educational philosophy has been proposed for the solution of this problem by those who advocate such methods.

Secondly, if the liberalizing content is confined to the first year or two of the college course it must of a necessity be of a very elementary character and lacking in sequence and continuity which is an essential element in all educational work, though not recognized as fully as it should be in colleges of liberal arts. Fragmentary courses are of doubtful value.

Thirdly, it is obvious that it is unwise to discontinue the scientific background of mathematics, chemistry, physics and their applications since presumably this is the *field in which the student is interested,* and also once this thread is cut by the interposition of other studies it is difficult to reunite it again.

For these reasons and others the writer believes with Mr. Wickenden that the solution of this problem is to lengthen the curriculum as far as possible, but to keep the scientific and engineering core intact and continuous. This automatically introduces the liberalizing content as a wedge, expanding upward, the major portion of the liberalizing content coming in the upper years instead of the lower years. There are two very important advantages of such a plan. First, it brings the liberalizing studies somewhat later in the course and at a time when the student is more mature and better able to make an intelligent choice. In other words, it minimizes the amount of such instruction that is forced upon him. Secondly, it provides for sequential instruction in a few subjects which may be economic or historical through several years of college life, thus giving the student something really worth while.

In conclusion the writer would add that the preceding discussion is not purely theoretical. For a number of years past the Sibley School of Mechanical Engineering, a component part of the College of Engineering at Cornell University, has

been experimenting with this idea and has found no defects in the plan. Whether engineering education will eventually go upon a graduate basis is an open question, but until that time comes, the writer believes the ideas outlined in the foregoing offer the best means of liberalizing the educational content.

R. L. SACKETT.

ROBERT LEMUEL SACKETT

The father of the retiring president of the Society was a surveyor and civil engineer in Mt. Clemens, Michigan. The son had an extensive and varied experience before going to the University of Michigan and during the summers before graduation in civil engineering in 1891.

He entered the River and Harbor Survey work of the Great Lakes and was employed on the investigation of the Grand River.

He was appointed an Assistant Professor of Mathematics at Earlham College, Richmond, Indiana, and later became head of the department which had expanded to include pure and applied mathematics, mechanics, surveying and hydraulics.

His engineering practice included the construction of water supply and sewage treatment works for the State of Indiana. A sanitary survey of the White River was one of the earliest investigations made for the State Board of Health.

Mr. Sackett was appointed Professor of Sanitary and Hydraulic Engineering at Purdue University in 1907 and planned the hydraulic laboratory for that institution. He was Consulting Engineer to the Indiana State Board of Health and assisted in the progress which the State made in the field of public health. He designed a number of water and sewage works for state institutions and cities. Later his available time was devoted to consultation.

In 1915 he was invited to be Dean of the School of Engineering at The Pennsylvania State College where he has been since that date.

Dean Sackett is a member of the Society for the Promotion of Engineering Education, The American Society of Civil Engineers, The American Society of Mechanical Engineers, The American Waterworks Association, and various other societies and clubs. He is a member of Sigma Xi, Tau Beta

Pi and is Vice-President of The American Association for the Advancement of Science.

A book by Dean Sackett on Engineering, designed for high school students and teachers, college freshmen, and occupational advisers is just off the press.

His recreations have been sailing, fishing, water color sketching and travel.

THE CHANGING EMPHASIS IN ENGINEERING EDUCATION *

BY R. L. SACKETT,

President of the Society, 1927–28

The scrutiny to which engineering education has been subjected in the last few years has brought with it a new emphasis on almost every factor entering into the practices, persons, and purposes involved. What definitive progress will result remains for the future to unfold. Undoubtedly, there will be a quiet and continuing evolution. Those who are self-satisfied do not investigate; so we are evidently aware of the dangers of complacency. Are we mystified by the multiplicity of roads by which we may progress from the present to a future of higher achievement? As a result of the survey there seem to be clearer objectives in sight and more definite lines of approach to them.

What are some of the more evident trends? How logical and permanent are they? There are certain powerful, social changes taking place and it is inevitable that engineering should be changing also because it is an instrument of social as well as of material progress if it is to fulfill its promise and its possible destiny.

The emphasis is changing from wealth to health, to leisure and to opportunity—from material progress to spiritual attainment.

The engineer is contributing to community and rural health. He is also a great promoter of safety and security. He is the greatest factor in an industrial evolution, which is bringing with it the satisfaction of material needs and a supply of leisure for the majority of industrial workers. There are some who believe that industrial America is chasing itself around a circle and that we shall end where we started, fa-

* Presidential Address delivered at the 36th annual meeting of the Society, University of North Carolina, Chapel Hill, June 26–29, 1928.

tigued by our breathless haste to get nowhere. There are others who believe that we are advancing over our dead selves in mounting spirals. Who is right depends more on the engineer than on any other social force at present in evidence.

The public has come recently to admire the more spectacular works of the engineer, his great bridges, tunnels, dams and power plants. He is rarely recognized as determining the policies of some of our great utilities, our systems of transportation, and of communication. His influence in the evolution of our complex industrial organism is still less appreciated. The contributions of the research, the designing and the construction engineer are obscure.

The operating engineer comes closer to the public than any other and he is probably responsible to a degree for the standing of the profession before the bar of public opinion, but the latter classes him as an executive and not as an engineer.

What training has the engineer had in preparation for the conduct of the utilities which are the great servants of the public today? His education has been very largely in the underlying mathematics and sciences, the principles of design, questions of efficiency, and to a limited extent, in dealing with the problems of practical economy and of the organization involved in efficient operation. Only a few have received instruction in the elements of industrial organization or management; fewer still have had their attention called to social and economic movements and their influence on the policies of public utilities and on the relations of the latter to the public. The investigation which has been conducted of engineering education has pointed out that engineering instruction confines itself to materials and natural forces, to the exclusion of those human elements which are even more important in the major operations of the engineering profession. Repeatedly, has our attention been called to the fact that more than fifty per cent of our engineering graduates are ultimately promoted to administrative positions where their relations with employees and the public constitute their most important functions. In spite of the considerable evolution

which has taken place in the scope of engineering, our instruction is largely confined to the elements with which engineering education began a hundred years ago. The continuance of this emphasis upon the material side of life to the exclusion of or with minor emphasis on the human side is a reflection on the breadth of training of the engineering teacher and constitutes an indictment on his vision of the future of engineering.

There are three fields of engineering instruction which seem to call for more emphasis than they have received in the past.

Economy in Production and Transportation

The future development in industry, transportation, and communication depends very largely on our ability to maintain high wage scales and at the same time produce goods and distribute them with increased economy. The problems of comparative cost, quality, and service should, therefore, be a part of the instruction in design and of the problems of operation so far as they are examined in engineering curricula. This does not imply additional courses of instruction, but there should be more emphasis in courses long given to illustrate the items of cost and economy which are involved.

Reasonable emphasis on the industrial significance of cost is justified. This requires experience, a realization of its place and a sense of proportion by the engineering teacher.

Economics

A few years ago the engineer and the teacher voiced the thought that engineering instruction should be broader and less specialized. Economics should be a part of the curriculum, a view which was quite correct and the subject was introduced, if it had been absent. A very few years have proven that it is not adequate. As a result of it the engineering student receives an academic point of view but does not obtain a clear picture of the economic structure which forms the foundation of a healthy industrial life. The engineering teacher needs to supplement the theory of economics by ap-

plications which will illustrate the relation of engineering to economics and of both to a wise industrial program.

The growth of a sound economic or industrial philosophy is of increasing value to the engineer as well as to the citizen. Again, it is not the addition to a crowded curriculum that is necessary to balance the educational budget but a better understanding by engineering teachers of the elements of a healthy industrial doctrine. When we have it, then it should be woven into the fabric of engineering training.

Congress has repeatedly illustrated its incapacity to analyze the great economic problems confronting us. The lawyers who compose our legislative bodies are too frequently swayed by precedent or policy rather than by principle. Nor will engineers enter our legislatures in numbers sufficient to influence thereby their acts. It is notable that physicians have not been elected to legislative bodies in any numbers but they have been an instrument in obtaining the passage of protective laws of high character including largely those which make the services of the sanitary engineer so valuable. These laws have not been demanded by the people; a considerable body of them protested against acts and ordinances which invaded personal rights and ancient liberties. Experience has justified the foresight of the public health officer and the sanitary engineer.

The Interstate Commerce Commission and engineers foresaw the future of transportation, communication and power development ahead of demand. The Federal Water Power Commission has modified the old common law of riparian rights.

These are all economic questions and the voice of the great engineering societies with their membership of 50,000 might have accelerated certain movements if there had been vision and a unity of policy anticipating these great social changes.

The engineer ought to determine and probably will determine in the future his professional objectives and illuminate them more clearly than he has. If he has them well defined in his own mind, he has not conveyed that purpose to the public in a convincing message. The people admire

his spectacular works but his day-by-day contribution is not yet comprehended. The engineer himself is inarticulate and the profession is lacking in professional consciousness. Was it Kipling who said "The scientist is the only one who has anything to say and *he* doesn't know how to say it!" The scientist has found his tongue but the engineer lets his works speak for him and, imposing as they are, they nevertheless need an interpreter. The great engineering societies are bound to be the chief medium through which a unified professional purpose is formulated just as the American Medical Society is the mouthpiece of the physician. Faith without works is dead is as certainly true of engineering as of any other creed. We have the works and they are impressive but we do not yet have a faith.

Over 50 per cent of the membership of our great engineering societies is composed of college graduates; 75 per cent of the accessions are college trained. It is therefore an axiom that in a few years the engineering graduate of yesterday, to-day, and to-morrow will be writing our message. It seems clear that those who embody the principal results of engineering instruction leavened by experience will write the major theme of engineering purpose in the future.

The third subject which it seems to the writer is worthy of emphasis is:

Management

The age of material development has not yet passed but there is being imposed another element to which less attention has been paid. Twenty years or more ago a phrase was coined which had many indefinite implications. It was received with skepticism, doubt and denial. Its advocates were intemperate and visionary, but nevertheless they had a vision. Those who came to scoff at "Human Engineering" can now remain to pray. It has developed a body of experimental and scientific knowledge, the essence of which was expressed a year ago in a form that he who runs may read to advantage. And still we of engineering education have not caught or accepted the full significance of the idea. After one hundred years

of engineering education we are just beginning to perceive that the human element is the supreme factor of importance. We have not yet developed the essential factors of management in a form acceptable for certain teaching purposes. For the *industrial engineer* there is a promising body of knowledge in form for his instruction and for his professional uses. No other class has been more alert in sifting and selecting principles and practices of value to the human element in industry.

There remains however another step and the direction in which we go depends on three factors. First, much is said about the need for able executives and we know that from 50 per cent to 75 per cent of our engineering graduates become executives after an experience varying in length and character.

Secondly, the belief exists that executives are born, not made. And in the next breath we hear of methods for developing good executives or better executives. Education means development and development is growth. When does the process begin of growing a good administrator? Some say that "outside activities" around college are the great sources of inspiration and development of potential executives. Either colleges are futile in their purpose to train men or outside activities are divinely appointed agencies, their wonders to perform. Forsooth, running a college paper or managing the football team may be a valuable outlet for undirected human energy and may be wholly justified on other grounds but as *media* for the *development*, the training of our future executives, they are non-essentials unless utilized in a systematic scheme of education. The indictment is not of the boy or of his natural desire to do something for the fun of it. The college is not using them as training tables for future managers nor should it of necessity do so. There is a justifiable value in letting outside activities alone so long as they are run decently and their bills are paid promptly.

First, engineers frequently become executives and the future numbers and percentages of graduates in that field should and will increase.

Second, executives are developed either by their own efforts or by outside influences or by both.

Third, if the above statements are true then there should be a body of instruction formulated for those who are not planning to enter manufacturing but who have better than an even chance of becoming directors of the efforts of bodies of men engaged in civil engineering lines of construction and operation, in electrical development or in mechanical engineering.

My belief is that we are justified in considering a rational development of aids to personal efficiency and to group efficiency which depend on leadership or management and that a body of knowledge is being developed for the purpose of directing the attention of maturer students to these important elements of modern engineering. Time is necessary to develop the best technique but an appreciation of the changes taking place in our social structure is important and is the first essential.

The changing emphasis in engineering means that we shall hold on to that which is good and strive sanely to add to our assets recognizing that engineering education is not static but dynamic, that it must keep stride with and also anticipate the changing order of society. We are not teaching the multiplication table only but also we are for many young men opening the portals to life with all its increasing complexities and necessary readjustments. That which is most permanent in education is that which is most applicable to the business of living and this is more than just getting a living.

The training of men to accept, or to look forward to, supervisory duties after experience is not only an opportunity for the man who is adapted to such a position but it is a great service—perhaps the greatest—to society. Sound, sane leadership has been from the beginning the critical factor in social evolution and the more complex the organism the more capable the leadership which is demanded. If engineering educators do not meet the demand, others will; the future

executive will have been trained to a greater degree than in the past. This, also, does not require a disturbance of the major subjects in the curriculum, but instead a realization by the teacher of the necessity of giving due consideration and emphasis to the change in the status of the engineer and the destiny open to him.

DISCUSSION

H. J. Hughes, Dean, Engineering School, Harvard University: President Sackett's address raises certain important issues concerning the education of the engineer and his place in industry and society. It is true that his work and activities are neither well understood nor thoroughly appreciated by the public. Unlike the physician or the lawyer whose services are chiefly to individuals or small groups, the engineer functions largely as a member of some organization; and the relatively few services he performs for individuals are, in general, comparatively modest. As the field of engineering activities increases in scope and magnitude, the individual engineer becomes less conspicuous. This seems to be inevitable; yet that is not a good reason, as the speaker has said, why engineers as a group should be so incoherent and silent on great public and economic questions, especially in the many instances where they, of all the professional groups concerned, are the most competent to speak with authority. It is high time for the engineer to make his work known and to take a more active part in public affairs. Indeed it is not too much to say that the general lack of information about the varied activities and opportunities open to educated scientific men, combined with the reticence of many engineers, deter many able, ambitious and desirable young men from entering this profession.

It is my belief that the engineer has succeeded so well in executive and administrative jobs not in spite of his large dose of mathematics, physics and engineering sciences; but rather because he has had a kind of training which forces him to cultivate his powers of thought and to check his mental proc-

esses by concrete results. Moreover, most of his engineering studies in their very nature, force upon him the consideration of the economic problem. The objective of such studies is primarily economy; the most efficient type of machine, the cheapest structure that will safely serve its purpose, the best gradient for a railroad, and the like. The economic question is always before the engineering student; but, as the speaker has well said, this alone is not sufficient. More important than the subject-matter itself, are teachers who are capable of instilling into their instruction the lessons of their own experience in a way that will make the economic problem a live issue to the student. Unfortunately for our engineering schools, those qualities that go to make a first-rate teacher of engineering are also highly valued by industry, which can in most cases offer greater rewards than the schools. I am in hearty agreement with President Sackett that the economic problem can be dealt with effectively in the process of teaching engineering subjects. In my own case, for example, although fully a quarter of my course of study in the college consisted of economics, the studies which I took later in the engineering school and my teachers there, made economics mean something real to me.

Mr. Wickenden said yesterday that we ought to define the line between business schools and engineering schools. This, in my opinion, is far from self-evident; rather a better mutual understanding of the whole situation, and more co-operation is needed. Graduates of engineering schools are at present competing on at least even terms with graduates of business schools for a great variety of business positions. And, although I see great merit in much of the training provided in the business schools, I do not believe that the business instruction has as yet reached a development that justifies the substitution of any large amount of business courses for engineering and other scientific subjects in the four-year programs, nor that in themselves business subjects are a better preparation than engineering subjects for most of the executive jobs in the industries.

Executive ability, or qualities of leadership cannot be created by educational processes; but such qualities can be brought out and developed by study and practical training. There is available in printed form a large amount of material for the student of business methods. Much of it is of an informational character, both interesting and instructive, but of doubtful merit from the standpoint of a rigorous education; but there is a considerable body of well developed fundamental principles applicable to business problems. With these principles, the engineering student should as far as possible be made at least familiar. The dilemma is, that in the four-year course of study there is not time to deal in any adequate formal way with business subjects without sacrificing engineering and other subjects which, in my opinion, are more important to the engineering student, whatever his future work may be. In five years, or in six years, a satisfactory combination of instruction in both engineering and business can be provided; but the four-year course is now, and is likely to continue to be, our real problem.

A suggestion for dealing with the business subjects in the four-year engineering programs, and at the same time helping students to learn to read serious books effectively, is prompted by an experiment called "the reading period," recently started in Harvard College. In the more advanced subjects class-room work is suspended for the last two weeks in the first term, and for the last two and one-half weeks in the second term; during these periods certain assigned reading must be done, for which the student is held responsible in the mid-year and final examinations. The plan already gives great promise of success. It would seem feasible that, for upper-classmen in engineering schools, similar periods might with much profit be devoted to the careful reading of selected books covering the fundamental business principles on which the students must pass satisfactory examinations. Such independent personal reading without instruction from teachers, even though of brief duration, would develop a sense of responsibility and give students an insight into the problems of

business, which would more than compensate for the time taken from other subjects. At the same time, the integrity of the programs as a whole would be maintained. We have not tried this scheme, nor have we adopted the reading period as a requirement, in the Harvard Engineering School. Teachers in charge of senior and graduate subjects may, if they wish, suspend recitations during the reading periods, and assign reading or special problems, which must be included in the examinations.

With experienced teachers who consistently emphasize the economic problem in their courses and with an incentive to read in business subjects on the part of the student, the four-year engineering course can be enriched without being weakened, and be made into a better preparation for certain types of executive positions.

Professor Harland: If Dean Hughes is here, I should like to know what some of the reading subjects are that are given to the students for that reading period or those two periods to which he refers.

Professor Dawes: Dean Hughes has been obliged to leave, but being at Harvard, perhaps I can answer Professor Harland's question. In the Engineering School we do not observe the reading period as a requirement. In courses for seniors and graduate students the instructor may, if he chooses, give his class a special problem or reading during the reading period. For example, in the course in Electric Railways, the professor in charge might well give a problem on working out acceleration, power curves and so on for a specific electric railway system; the student has opportunity for consulting with the professor at such times as he wishes. If the course is in Alternating Currents and Alternating-current Machinery, the instructor might well give the design of some electrical machine for the student to work outside.

I believe some professors do assign definite reading in the subject matter of the courses as suggested by Dean Hughes. I think he is speaking of the possibilities in connection with business subjects and not something that we actually do. Does that answer the question?

Professor Harland: Yes.

C. C. Williams, Dean, College of Engineering, State University of Iowa: President Sackett's message is distinctly one of encouragement and good cheer. After his years of experience and observation in engineering education, and more especially after his year of elevated view as president of this Society, he concludes that emphasis is shifting from material progress to spiritual attainment and he portrays the engineer as a potent factor in this change. The distinctly spiritual tone of the reply sent to the recent Kansas City Convention from that distinguished engineer, who seems destined to be the next successor to that other engineer-statesman, the immortal Washington, illustrates the point. How refreshing and heartening it all is!

Perhaps after hearing the President's thoughtful address, we may wonder that engineering education has been so slow to recognize the whole of its problem. In the century-old definition of the engineer as one who uses the forces of Nature for the benefit of man, we have fixed our attention so completely on the forces and materials of nature and how to use them with so little thought to the second member of the equation—which is no less important—namely, the "benefit of man." In fact engineering education for many years almost ignored the question of what constitutes the benefit of man, and only recently has the fact that the social and economic factors are pertinent and vital in the engineer's province, as well as the forces and materials of Nature, and have been given attention. The development of social and corporate organization to match the engineer's advance in machines and processes has compelled the engineer to give scientific study to the very complex element of his vocation "the benefit and needs of mankind."

The same social and economic forces that have caused the amazingly rapid growth of colleges of commerce are having a marked influence on the objectives of engineering education. With his usual discernment, Dean Sackett has given us the measure of this influence. Although recognizing

the need of coordinating engineering with commercial enterprises, he happily has not urged, as some have done, such a transformation of engineering curricula as to constitute a half breed of economics and technics. The engineer, as envisioned by our President, is to remain an engineer, true to his ancestry of builders and to his training in science, and the 50 to 75 per cent who become executives will become such by virtue of their technical skill supported by their native administrative abilities, rather than by tricks of advertising.

Dean Sackett has drawn the outlines of engineering operations showing the shift of emphasis to new aspects. I should like to add briefly as a corollary what seems to me to be the corresponding change of emphasis in our educational operations. Less emphasis on the choice of subject matter and more on, first, the teaching, and second, the student, constitute the essence of this change.

With regard to the teaching process we are beginning to see that our function is not so much to impart technical knowledge as it is to train young men to think and to express their thoughts, using the principles and practice of engineering as exercises. In this process the particular subject matter utilized for this purpose is secondary in importance to the mode of teaching. Incidentally, we impart a certain measure of information concerning engineering science and practice, and it is highly important that this information be fundamental and reliable. Exact statements of principles and observed facts with their limitations and irregularities are vastly better subject matter for student thinking than perfect suppositious and artificial cases evolved from the instructor's inner consciousness. For this reason, a sufficient amount of practical engineering experience should be included in the preparation of engineering teachers.

The test or criterion of our success in teaching is not the obvious fluency of the lecturer nor the interest manifested by the student, but it is rather, whether the student has acquired the power to instruct himself further, and to think

creatively concerning whatever subjects may be brought to his attention.

As engineers, we believe in specifications and in inspection; as teachers, we apparently believe in neither. We boast of engineering as an exact science; in teaching we have vague standards, if any at all, and we follow a grossly inadequate system of inspection to ascertain whether or not whatever standards we do have are being attained. The result is that our engineering teaching is frequently inefficient and uneconomical.

One objective of the recent study by the Board of Investigation and Coordination was to ascertain how engineering education might be enriched. Such enrichment can be accomplished only through the teaching process. It cannot, in my opinion, be accomplished through a change in subject matter. The addition of so-called cultural subjects in the small amounts that are practicable is well nigh futile. Enrichment must come through the teaching, through the employment of teachers of richer and riper experience and of more ample training and background. A large factor in the impoverishment of the instruction in many liberal arts colleges is the employment of tyros as teachers in much of the undergraduate work while they are in the graduate school working toward advanced degrees. I believe that in most of the first class engineering schools, the maturity and capacity of teachers in the subordinate ranks have been notably improved in the past decade.

There is a danger, with the moving pictures and the development of so many marvelous means of communication, and the advancement of pure science into realms where few of us have been able to follow, that our teaching will take on the character of entertainment, that it will foster superficiality rather than rigor and depth, that we may merely spray our students with information rather than develop mental fibre. A poor teacher with all the paraphernalia that can be crowded into a classroom will not equal one strong stimulating teacher alone with a piece of crayon and a blackboard.

Coordinate with the teacher and the teaching process, the student—his aptitudes and aspirations—is receiving attention in the new shift of emphasis in engineering education.

The demonstrated reliability of the more improved forms of placement tests has made it possible to begin the individual consideration of the student at his entrance to the freshman year. Orientation and similar courses and lectures are given as general guides, and machinery for personal conferences has been set up. Effort is being directed to predict success or failure with a view to avoiding the waste and the embarrassment resulting from failure after trial.

The report of the committee of this Society, of which Dean Sackett was chairman, on Engineering Students at Time of Entrance, threw new light on the individual treatment of students. Perhaps nothing was found in the entire investigation more startling than the great waste of material and of effort in the process of engineering education. It is quite clear that we have been following Nature's prodigal method of trial and rejection. Nature's waste in seeds, for example, is different only in degree from our waste of human material and of funds in our trial and rejection method of engineering education. If we can be aroused to the seriousness of this waste and of the need for study of the human material with which we have to deal, engineering education will have made progress. Even still greater emphasis must be shifted to the problem of discovering the student.

With this in view, three factors require consideration and evaluation, viz.: the intellect, the will and the ideals of the student. Determining the boy's intellectual capabilities and capacity is one thing; ascertaining his desires, his ambitions, his aspirations, and his will to achieve is another, and not less important. The quality of his determination, the extent to which he will forego personal pleasure and early recognition to attain higher achievement later, the fibre of his moral backbone, whether his purpose is to exploit or to serve humanity, are all matters still in the realm of conjecture.

To train these qualities of will and of ideals, our educa-

tional objectives must include more than intellectual exercises. A few years ago it was my pleasure to visit Oxford where living and learning are not sharply separated. I was impressed with the statement of a Rhodes scholar from the University of Iowa, to the effect that Oxford is not so much an education as it is a mode of living. Training of the will to achieve and establishing ideals of standards of achievement and wholesomeness of purpose constitute a part of life and comprise more than the drafting room and laboratory. If I understand correctly the views of some of our educators of most discerning vision, it is that our problem involves, as Dean Sackett has pointed out, purposes and ideals of living as well as the formal mental exercises of the class room. These are not functions of subject matter, but rather of the influence of the teacher and of the native potentialities of the student. If the faith expressed in the President's address that a change of emphasis to the second member of the engineer's equation, the "benefit of man" with corresponding changes of viewpoint in educational methods, is well founded, then, indeed, has an advance been made in engineering education.

A STUDY OF PLACEMENT EXAMINATIONS *

By

H. P. HAMMOND, *Associate Director of Investigation,*
Society for the Promotion of Engineering Education,

and

GEORGE D. STODDARD, *Associate Professor of Education and Psychology,*
State University of Iowa.

Purposes. The study described in this bulletin was intended to test the usefulness of the Iowa Placement Examinations in engineering colleges. These examinations constitute a series of educational tests designed to measure the training and aptitude of students for subjects commonly included in the first year of engineering curricula. A more complete description of the examinations will be found in the following pages. The trial of the examinations was made by a group of engineering colleges and other institutions in the years 1924–25 and 1925–26. Almost all of the material which follows is based upon the results of that trial. An exhaustive discussion of the various types of special examinations, intelligence tests, and other kinds of educational measurements that have been developed in the past few years will not be attempted, nor will the more technical aspects of the preparation and analysis of such tests be dealt with.† Since, however, placement examinations are designed to serve the purpose, among others, of sectioning classes on the basis of ability, a brief discussion of that procedure will be included.

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† A more extended technical discussion of the examinations will be found in "Iowa Placement Examinations," by George Dinsmore Stoddard; Volume III, Number 2, of *Studies in Education*, issued by the State University of Iowa.

Auspices. The Iowa Placement Examinations were constructed by Dr. George D. Stoddard under the general direction of Dean C. E. Seashore of the Graduate College of the State University of Iowa and Professor G. M. Ruch of the College of Education of that institution. Assistance in preparing the examinations was given by members of the faculties of the several departments of instruction to which the examinations relate. The Society for the Promotion of Engineering Education, under whose auspices the present study was conducted, through the Staff of its investigation of engineering education, cooperated in having the examinations given to students and assisted in securing their scores in the examinations and grades in corresponding subjects of the freshman year.

Colleges Participating in the Study. The institutions which participated in the trial of the examinations furnish a representative sampling of the engineering colleges of the country. Five are polytechnic institutes and schools of mines offering engineering courses only, three are privately endowed arts colleges and universities, six are land-grant colleges, twelve are state universities, and one is a municipal university. Twenty-three other institutions which do not offer engineering courses also participated, but the number of their students who took the examinations was relatively small, more than two-thirds of all the students reported upon being definitely enrolled in engineering courses. The institutions are quite well distributed in the various parts of the country, there being some preponderance of institutions in the Middle West. All of the institutions represented in the study admit primarily by the certificate plan.

The number of cases reported upon was amply large to warrant the conclusions drawn on the following pages. The numbers of students taking the various examinations ranged from over eight thousand in the English Aptitude Test to about one thousand three hundred in the Physics Training Test. The numbers of students whose first semester grades were reported was smaller but was ample for any desired

analysis and discussion of the results, the number in mathematics, for example, being over one thousand. In many instances results reported in this bulletin are based upon a sampling of cases drawn from the whole number, but in no case is an inference drawn or a result reported concerning which there is any important statistical doubt.

Relationship of Placement Examinations to Other Kinds of Special Tests. In the past few years, and particularly since the war, the science of educational measurement and the use of special kinds of tests, such as so-called tests of general intelligence, have made rapid progress in higher education. Such measurements and tests have probably been applied to a less extent in divisions of education which prepare for the professions than they have in general collegiate courses. They have, nevertheless, been applied to some extent in engineering education. Great impetus was given to the whole science of educational measurement through the use of the Army Alpha Test in the American army during the war. In engineering education, the report of Dr. Charles R. Mann * in which he discusses the special tests of engineering aptitude constructed by Professor E. L. Thorndike had considerable effect in promoting the use of special tests of various kinds. In fact Dr. Mann's report led directly to a trial of special forms of examinations by a considerable number of engineering colleges pursuant to the following resolution passed by the Society at its annual meeting in 1919:

> "... That this society through its Committee on Admission, or otherwise, recommends that as a matter of experiment and research, psychological, 'objective,' 'trade,' or other similar tests be given to all students after admission to engineering courses of study and that the ratings thus obtained be compared with their subsequent scholastic progress."

In accordance with that resolution six tests were prepared under the direction of Professor L. L. Thurstone and a special

* *A Study of Engineering Education*, by Charles Riborg Mann; Bulletin Number Eleven of the Carnegie Foundation for the Advancement of Teaching.

committee of the Society and were administered to over seven thousand students at the time of their admission to engineering colleges. Discussions of the results will be found in the publications of the Society for the years 1920, 1921 and 1923. This experiment may be regarded as a part of the general movement in higher education toward objective valuation of student abilities and performances. It had as its purpose the measurement of general aptitude for the study of engineering. In its immediate purpose the experiment differed from the trial of the placement examinations, as will appear later.

Function of Placement Examinations. The general purpose of the kinds of tests to which reference has been made is the measurement of scholastic aptitude as a means of predicting probability of success in courses of study extending beyond the point to which the student has advanced. The placement examinations are designed to serve that purpose more specifically by measuring the aptitude and the preparation for particular subjects of the curriculum. At the same time the composite score of the entire series of examinations, or any considerable part of the series, serves as a general measure of scholastic aptitude. Each of the examinations comprising the series relates to one of the subjects commonly prescribed for the work of the freshman year of engineering colleges. The purposes of the examinations are best summarized in the following words of Dean C. E. Seashore:

> (1) It will be devoted to a single subject or field of knowledge such as English, mathematics or chemistry;
> (2) It will differentiate between training in a subject and natural aptitude or fitness for that field of work;
> (3) It will be a departmental affair and will be given separately by each department in its immediate interests and needs;
> (4) It will serve as an introduction to the subject, being prepared partly with the purpose of reminding the student of the essential prerequisites for the course and indicating the general character of the activity that will be pursued in the course, and being so written from the point of view of the art of teaching that it shall constitute the most profitable exercise for the first two hours of the course;

(5) This examination should give, at the end of two hours, as adequate information about the student's place and needs in the course as the instructor ordinarily acquires by the end of the first semester under the traditional methods of instruction;

(6) The record of a general intelligence test may be used to supplement this examination, but that is not essential, as a series of placement tests will be more significant than a general intelligence test;

(7) It will be prepared by or in responsible collaboration with a successful teacher and writer in the specific subject;

(8) It will be given for a specific purpose and the results will be applied immediately in the organization of sections of the class on the basis of this objective information about the character of the preparation and the natural aptitude for the subject.

The results of the examination in accomplishing these purposes will be discussed later.

Placement examinations have not as yet been used as a definite requirement for admission to college—nor, with a few exceptions, have other similar tests—though they have been employed as parts of general admission procedures. If desired, they may, however, be used as a basis for the selection and admission of students either as a definite requirement or as a means of giving advice as to the probability of success or failure.

Placement examinations also furnish information to teachers and educational advisers whose duty it is to deal with individual students and to render advice and assistance to those in scholastic difficulty and to those of superior ability who merely do enough work to pass the formal requirements of their courses.

Description of the Examinations.* Each examination deals with a particular subject commonly included in curricula of the freshman year and is divided into two parts: one a test of aptitude and the other a test of training.

* Sample copies of the examinations may be obtained from the Bureau of Educational Research and Service, The State University of Iowa, Iowa City.

The aptitude test is a special type of intelligence test designed to measure those skills and abilities which bear particularly upon the subject in question. It is designed, in so far as possible, to measure specific aptitude for that subject rather than scholastic aptitude in general, and to measure these qualities irrespective of the training which the student has had in the subject in question in the secondary school. The aptitude test is not entirely, as its name may imply, a test of innate or native abilities, nor is it intended to eliminate completely the measurement of scholastic preparation, but it is intended to measure those portions of the student's "preparation"—scholastic and otherwise—which while not given in school in the particular field of the subject do nevertheless have a bearing upon the probability of success in it. The Chemistry Aptitude Test, for example, is designed to measure ability to make simple arithmetic and algebraic computations, to measure reading comprehension, *i.e.*, the ability to comprehend and interpret written statements of various degrees of difficulty and complexity, and to determine the student's interest in chemistry from the extent and the accuracy of such information concerning chemistry as any intelligent youth might have acquired from popular reading or in other ways in daily life. These measurements do not determine the extent or quality of the student's preparation in the specific field of chemistry as acquired in the secondary school but they do measure certain factors which have an important bearing upon subsequent scholastic success in that field.

The Chemistry Training Test is designed to measure accurately and objectively how much knowledge of the subject has been retained by the student. The chemistry test, for example, measures knowledge of fundamentals of chemical processes; determines the extent and accuracy of the student's knowledge of valencies, formulas, names of compounds and the use of chemical formulas; tests ability to solve chemical problems; and examines the student on his knowledge of chemical manufacturing processes.

The "objective" type of question is employed throughout the tests. Certain questions are of the *true-false* type con-

sisting of a statement, the correctness or incorrectness of which the student is required to indicate. Others are of the *completion* type wherein certain words or phrases are omitted which the student is required to supply. The so-called *multiple-response* type in which several alternative answers are supplied and the student is required to choose the correct one is also employed. Certain of the questions are of the *recall* type which is similar to the usual examination question but is answered by supplying merely a figure, a word or a short phrase.

Two editions of the examinations have been published, a trial edition in the fall of 1924 and a revised edition in the fall of 1925. The revised edition was prepared after the experimental trial of the first edition and embodies such modifications as appeared desirable in the light of the results of the trial series. The complete set of examinations now consists of the following parts:

Chemistry, Training and Aptitude,
English, Training and Aptitude,
Foreign Language Aptitude,
French Training,
Spanish Training,
Mathematics, Training and Aptitude,
Physics, Training and Aptitude.

A brief description of the Chemistry Aptitude and Chemistry Training examinations is given below as an illustration of the subject matter covered in the tests. A complete summary of the same kind covering all the examinations is given in the Appendix beginning on page 63.

CHEMISTRY APTITUDE, CA–1 (125 items, 44 minutes).

Part 1. (20 items, 15 minutes.) Simple arithmetical relations which appear in chemistry.

Part 2. (30 items, 12 minutes.) Three paragraphs are presented covering college textbook material in chemistry, followed by precise questions which measure the student's ability to read exactly and to resist generalizations.

Part 3. (15 items, 12 minutes.) A measure of chemistry reading comprehension which, for correct answers, requires a grasp of the ideas and relations involved.

Part 4. (60 items, 5 minutes.) Interest in chemistry is measured by simple factual questions of the true-false type which indicate the accuracy of the student's general knowledge of chemistry. Students with a particular fitness and liking for chemistry acquire this knowledge incidentally.

CHEMISTRY TRAINING, CT–1 (152 items, 43 minutes).

Part 1. (45 items, 8 minutes.) Knowledge of fundamentals of chemical processes.

Part 2. (45 items, 12 minutes.) Covers valencies, formulas, names of compounds, and the completion and balancing of equations.

Part 3. (50 items, 8 minutes.) Manufacturing processes and the applications of chemistry.

Part 4. (12 items, 15 minutes.) Fundamental chemical problems in which the mechanics of arithmetic are reduced to a minimum.

The examinations are administered in accordance with a procedure given in a Manual of Directions furnished to teachers giving the tests. Specified time limits are set on each part of each examination and the students are required to pass to the next part upon expiration of the designated time. At the end of the time permitted for each complete examination, papers are collected. The papers are scored by use of a scoring key in which the correct answers are supplied. Scoring is essentially a clerical process and is done rapidly by comparison of the answers with the key. Items are marked either correct or incorrect and no part credits are given. The total score in the true-false tests is obtained by subtracting the number of incorrect answers from the number of correct answers, the minimum score being zero. The total score on a given examination is the weighted total of the scores on the several parts, each part being assigned a weighting as indicated in the key. With the exception of the language and mathematics training examinations, scoring may be done by one not familiar with the subject matter.

General Purposes of the Examinations. It should be understood that the primary purpose that the examinations are designed to serve is the measurement of probability of scholastic success; specifically, the measurement of those factors that have important bearings upon the likelihood of success *in the freshman year*. Since, as has been amply demonstrated, scholastic ability is, in general, a quite permanent quality, any instrument that measures factors contributing to success in the freshman year will also be indicative of success in later years of the curriculum, though possibly not to the same degree due to the operation of a number of influences which lie beyond the scope of educational measurement. No definite attempt was made in constructing the examinations to measure factors contributing to success in engineering after graduation, except in so far as such success is indicated by scholastic achievement.

Another purpose of the examinations is that of indicating individual differences among entering students. If this is accomplished adequately, it is an important contribution to educational practice in view of the heterogeneity of the product of secondary schools entering college, and it is of particular importance in the case of students beginning the study of engineering with its exactions and inherent difficulties. Information of this character, when accurately determined and used with discretion to advise and guide both the able and the weak students, may aid in the solution of some of the most difficult problems of student personnel.

While the intention is to have the examinations serve these purposes, they should be regarded only as tools. Examination scores, by themselves, can not be expected to do anything. It is only when the results serve as the basis of improvement that they are of real value. Among the ways in which indications of student abilities and preparation may be employed are: early elimination of the demonstrably unfit; separate classes or sections for the poorly prepared but able; greater opportunities for the gifted and well prepared—all of these, and others, are measures which may be taken as a result of the examinations.

Validity and Reliability of the Placement Examinations. Inasmuch as the placement examinations comprise a series of mental and educational tests designed to measure certain facts, there are points concerning their "internal behavior" which should be examined; it is necessary to go beyond the previous statements which simply summarize their content in a general way.

The first and most important question is: Do the examinations really perform the functions for which they were devised? In order to give an adequate answer to this question it must be established that:

The examinations reveal individual differences in aptitude and training for the various subjects among entering students.

The examinations predict, to a useful degree, the subsequent performance of students in each subject.

The examinations can be used successfully in sectioning classes, in treating individual delinquencies and in various other aspects of personnel work.

There is a real distinction between *training* and *aptitude.*

The examinations are reliable, that is, are consistent in their measurements.

These points will be discussed briefly in the following pages. In following the discussion it should be borne in mind always that the criterion upon which the results of the placement examinations have been evaluated is, in almost every instance, scholastic achievement in college as measured by instructors' grades. These grades are to a certain extent, in fact in many instances to a large extent, subjective, and their accuracy as an index of student achievement is relatively low. This, it appears to the writers, is particularly true of the grades of students on the border between passing and failure since, and rightly perhaps, the instructor often "gives the student the benefit of the doubt." The use of instructors' grades as the criterion against which to judge the accuracy of prediction of scholastic achievement given by the placement examinations is, of course, inevitable in view of present practices, but it may be pointed out that when the scores of the placement examinations are compared with the scores in comprehen-

sive examinations of the objective type given at the end of the first semester of the freshman year, the correlation is materially improved. This condition should be remembered in connection with many parts of the discussion and in particular with reference to such data as those presented in Table 4, page 71 of the Appendix.

Individual Differences. The results of the tests indicate clearly that students vary tremendously in the skills and abilities represented in the examinations, ranging from scores close to zero to almost perfect performances. Figure 1, which

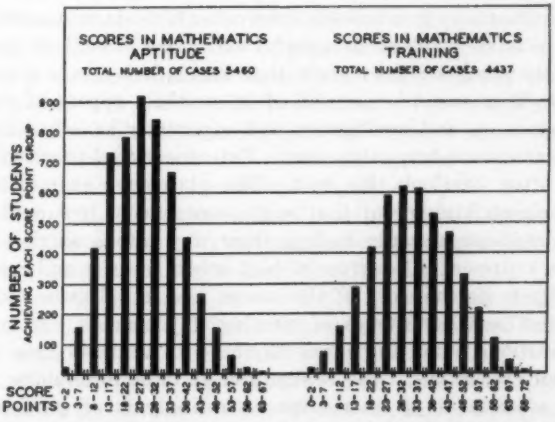

FIG. 1. Frequency Distribution of Scores in Mathematics Tests.

depicts the range of scores in a single division of the examinations, chosen as representative of all, and Table 2 (Appendix, page 66), which summarizes results in all parts of the tests, indicate the spread in performance among a large group of students representing all sections of the country. Thus, in the Chemistry Aptitude Test, the highest one per cent of the students scored 98 or above while the lowest one per cent scored only 10 or below. The total number of students taking this test was 5,917. Similarly in the Chemistry Training Test, the lowest one per cent of the students scored only 2 or less, while the highest one per cent scored 152 or more. When

it is recalled that every student who took the Chemistry Training Test had studied chemistry in high school, presumably for a year, this difference in the knowledge of the elements of chemistry is astonishing. A similar extreme variation in performance is the rule for all the other examinations. If this range be discounted somewhat because of possible inability of some students to adjust themselves to the conditions of this sort of testing, nevertheless, the divergence is very great and indicates that the tests do measure adequately differences of individual performance.

Since these observed differences are accompanied by associated differences in scholastic achievement, as shown elsewhere, they must be taken as meaningful variations in student talent. All observing teachers know that homogeneity in a class is not to be assumed because all of its members appear of about the same age and intelligence, and apparently have had about the same secondary education. Yet educational practices all too often overlook this fact. The placement examinations furnish striking proof that such homogeneity is superficial, that students actually finding their way into a single classroom represent all degrees of high school success and mental ability to do the work of the course, and, needless to add, of interest and persistence in meeting its demands. In many institutions admitting large numbers of students "on high school credentials," the recognition of these differences, and the adjustment of instruction accordingly is of paramount importance and is becoming increasingly recognized as such. It is not too much to say that lack of awareness of student differences is a major contributory factor in the maladjustment of beginning students, or that recognition of and provision for them may do much to minimize such maladjustment.

Prediction of Performance. The chief purpose that has been recognized for tests of the same general kind as the placement examinations is the prediction of the quality of future scholastic performance. As previously stated, the placement examinations are designed to furnish a prediction not only of quality of scholastic work in general but also of work in particular subjects. It is upon the accuracy of this

prediction that the real usefulness of the examinations to teachers and administrators chiefly depends and the matter will, therefore, be discussed in some detail.

It must be remembered, in this connection, that certain factors in addition to the limitations of the examinations themselves operate to restrict the accuracy of such prediction:

The fact that mental and educational elements are not the only constituents of successful achievement; interest, personality traits, health, environment, etc., are of consequence and are only indirectly measured in tests of the placement type.

Temporary variations in the behavior of individuals due perhaps to the operation of a number of small causes.

Aid given to individual students through definite provisions therefor in the institution wherein counsel and guidance are devoted to improving the performance of students found deficient by the examinations will operate to lower the prediction given by the tests—and rightly so.

The unreliability of instructors' grades which, through inaccurate measurement of student achievement, makes the prediction appear less accurate than it really is.

The Pearson coefficient of correlation is commonly used to express the accuracy of prediction of any educational measurement and has been employed for that purpose in this bulletin. This coefficient expresses the degree of similarity or correspondence between two sets of measurements of the same or related quantities or events: for example, as in this instance, between the scores in placement examinations and grades in corresponding subjects of the first semester of the freshman year. The higher the value of the coefficient, the closer is the agreement between the two measurements, a coefficient of 1.0 representing perfect agreement, 0 representing no agreement, and —1.0 representing complete divergence or disagreement.

The following table exhibits values of this coefficient for the several parts of the examinations.

Examination	Mean coefficient of correlation for all colleges reporting	Range of coefficient of correlation
Chemistry Aptitude	0.48 *	0.23–0.63
Chemistry Training	0.52	0.25–0.67
Chemistry Aptitude plus Chemistry Training	0.52	0.35–0.65
English Aptitude	0.46	0.25–0.69
English Training	0.54	0.28–0.67
English Aptitude plus English Training	0.52	0.33–0.74
Foreign Language Aptitude	0.52	0.36–0.73
French Training	0.56	0.45–0.65
Spanish Training	0.53	0.48–0.57
Mathematics Aptitude	0.46	0.16–0.65
Mathematics Training	0.51	0.34–0.65
Mathematics Aptitude plus Mathematics Training	0.51	0.37–0.71 †
Physics Aptitude	0.47	0.28–0.62
Physics Training	0.61	0.57–0.69 †

$$r = \frac{\frac{\Sigma xy}{N} - \left(\frac{\Sigma x}{N} \cdot \frac{\Sigma y}{N}\right)}{\sqrt{\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2} \cdot \sqrt{\frac{\Sigma y^2}{N} - \left(\frac{\Sigma y}{N}\right)^2}},$$

where

r = the coefficient of correlation,
x, y = variations from assumed means on the X and Y axes, respectively,
N = the number of cases,
Σ = summation sign.

This formula is equivalent to the one in which deviations are taken from actual means:

$r = \frac{\Sigma xy}{N\sigma_x\sigma_y}$, in which σ (or S.D.) represents

the standard deviation of the series. The standard deviation may be defined as the square root of the mean of the squared deviations from an arithmetic mean,

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}.$$

* All coefficients of correlation reported in this study were computed by the Pearson product-moment formula, through the variant printed on the Ruch-Stoddard Correlation Chart:

† Three colleges only.

It should be remembered in interpreting the correlation coefficients as measures of the predictive value of tests that it depends upon what is to be predicted whether a given coefficient, as say 0.50, is relatively high or relatively low. If actual place or rank in a class is to be predicted, for example if it is to be shown that a student is expected to rank eighth in a class of sixty, a coefficient of 0.50 is relatively low. If, however, the prediction is to be whether a student may be expected to achieve a grade of A or B, C or D, or E or F, that is, whether he is to be in the high, middle or failing group in his class, a coefficient of 0.50 is relatively high and indicates that the test may be expected to predict his scholastic achievement, quite accurately. Since this is the kind, or the *order*, of prediction usually desired by the college teacher and administrator and is the sort most useful in dealing with students, it is evident that the Placement Examinations possess good predictive value.

This is shown still more clearly by the following tabulations which indicate the grades in college subjects achieved by the students who placed in each tenth of the class in the scores on the Placement Examinations. Tabulations are reproduced for examinations in only two subjects; those for other subjects give about the same distributions.

Decile	Chemistry Aptitude First Semester Grades			Chemistry Training First Semester Grades		
	A + B	C + D	F	A + B	C + D	F
10	68%	31%	1%	70%	30%	0%
9	44	51	5	51	47	2
8	34	57	9	42	54	4
7	27	64	9	30	63	7
6	26	60	14	30	60	10
5	18	67	15	22	59	19
4	18	63	19	31	58	11
3	12	63	25	26	66	8
2	5	65	30	19	61	20
1	3	51	46	8	62	30
	Number of cases, 3,015			Number of cases, 634		

Decile	Mathematics Aptitude First Semester Grades			Mathematics Training First Semester Grades		
	A + B	C + D	F	A + B	C + D	F
10	55%	39%	6%	50%	43%	7%
9	48	41	11	36	56	8
8	38	55	7	30	55	15
7	25	58	17	28	58	14
6	22	63	15	15	63	22
5	19	59	22	25	58	17
4	22	59	19	9	60	31
3	9	60	31	7	58	35
2	12	57	31	5	50	45
1	7	42	51	0	39	61
	Number of cases, 1,931			Number of cases, 1,093		

In connection with the above tables it should be remarked that, obviously, the predictions of relatively high achievement or of failure are much more clearly indicated than is relative standing in the large group which normally constitutes the "middle" of the class. For example, only one per cent of those students who ranked in the upper tenth in the test scores on chemistry aptitude received a grade of *F* and failed to pass first semester freshman chemistry. This is but three students out of the three hundred who ranked in the upper tenth of the group in test scores. This proportion of cases is so small as to be accounted for by failures due to "external" causes, such as health, which are beyond the limits of this sort of educational measurement. On the other hand, almost one-half of the students in the lowest tenth on test scores failed the subject and only three per cent of this group, or nine students, achieved semester grades of A or B. The same thing, and to nearly the same degree, is shown by the rankings of students in mathematics. Approximately eleven hundred cases of students who took this examination (Mathematics Training) were tabulated, giving about 110 in each decile group. Only eight students in the upper tenth failed to pass first semester mathematics and over sixty per cent of those in the lowest tenth failed to pass.

If the grouping of students be made according to the

quarters of the class instead of tenths in the Placement Examination scores the prediction of first semester grades is naturally improved. Table 3 (Appendix, page 68) gives this distribution for all of the several examinations. Tabulations of results on this basis indicate in every case that the proportion of students ranking in the first quarter in the Placement Examination scores who did not pass the first semester's work in corresponding subjects was quite low, ranging from none to a maximum of ten per cent, and that the probable placing in the lowest quartile of those who failed to pass is quite large, ranging from a minimum of twenty-eight per cent to a maximum of fifty-eight per cent.

The validity of the Placement Examinations as measures of future scholastic achievement in comparison with other tests is shown by Table 4 (Appendix, page 71) giving coefficients of correlation for a number of well-known tests. It must be remembered in considering this comparison that all of the tests except the Placement Examinations are intended to predict scholastic success in general, that is, for all subjects of a given year, and not to predict achievement in particular subjects. Correlations of the former kind invariably tend to be higher than those between test scores and grades in particular subjects, in fact considerably higher. In spite of this tendency the Placement Examinations furnish correlations which are at least as high as those of the other tests. Correlations between composite scores in the entire series of Placement Tests and general success in the work of the freshman year are available for only those few institutions which administered the entire group of tests. For such as are available, the composite scores correlate from 0.65 to 0.75 with general academic work of the first semester of the freshman year. The highest of these figures is for the Case School of Applied Science, an independent polytechnic institute having an unusually homogeneous and well-prepared group of entering students. In Table 4 it will be noted that the correlation coefficients of the tests cited with scholastic work of the freshman year range from a minimum of 0.13 to a maximum of

0.62. The pooled scores of the Placement Examinations therefore seem to be a more valid index of scholastic achievement than do the results of the other tests. Table 4 also affords a comparison between the prediction of first semester grades in specific subjects in college by a number of tests and also those given by the Placement Examinations, the data for the latter being those previously given on page 38.

Although it was not one of the purposes of the trial of the Placement Examinations, and although the examinations are not intended to predict scholastic performance throughout the college course, some data have been gathered indicating the way in which the tests do predict performance beyond the freshman year. These data are decidedly relevant if the Placement Examinations be considered as possible instruments for the admission of students to engineering colleges, for, in the last analysis, it is the success of students throughout their course that is important. The following tabulation compares the results of the Iowa Placement Examinations with the Army Alpha Test and the Council on Education Tests in predicting the survival of students throughout the four years of their course at the Case School of Applied Science. The table also shows the value of first semester freshman grades in predicting student survival. It will be noted that no student who placed in the upper fifth of the group in the Placement Examination scores failed to complete his course because of scholarship, that three-fourths of those so placing survived to enter the senior year, all causes of elimination being included, and that sixty per cent of those in the lowest fifth of the class dropped out of college because of scholastic failure—a remarkable prediction. It is also to be noted that the Placement Tests are almost as efficient in predicting scholastic survival as are first semester freshman grades. Similar results as to the predictive value of the Iowa Placement Tests are given by data supplied by the Missouri School of Mines, not reproduced here.

PREDICTIVE VALUE OF TESTS GIVEN CLASS OF 1928 ON THEIR ENTRANCE TO COLLEGE
CASE SCHOOL OF APPLIED SCIENCE

ARMY ALPHA TEST — Given September, 1924
Number of cases 188

Standing on Test	% in Senior Class	% Out, Scholarship	% Out for Other Causes
Highest fifth	60	16	24
Second fifth	45	34	21
Third fifth	53	21	26
Fourth fifth	31	50	19
Lowest fifth	21	58	21

COUNCIL ON EDUCATION TESTS — Given September, 1924
Number of cases 189

Highest fifth	71	6	23
Second fifth	52	25	23
Third fifth	44	36	20
Fourth fifth	22	53	25
Lowest fifth	28	54	18

IOWA PLACEMENT TESTS — Given October, 1924
Number of cases 185

Highest fifth	77	0	23
Second fifth	50	27	23
Third fifth	44	33	23
Fourth fifth	23	49	28
Lowest fifth	19	60	21

PREDICTIVE VALUE OF FIRST TERM'S GRADES — February 1, 1925
Number of cases 193

Highest fifth	76	0	24
Second fifth	54	14	32
Third fifth	51	21	28
Fourth fifth	21	56	23
Lowest fifth	3	85	12

Sectioning of Classes; Personnel Work. The utility of the Placement Examinations as a means of sectioning classes is dependent upon their ability to measure those individual differences in test performance that are associated with differences in subsequent scholastic achievement. The success of the tests in this connection is indicated by the foregoing

paragraphs. A single illustration, drawn from the numerous data available, will serve to indicate the validity of sectioning on the results of the Placement Examinations. A class of 166 students was given both the training and aptitude tests in chemistry. First semester grades of these students are shown in the following tabluation:

Quarter of Class in Placement Examination Scores	Semester Grades in Freshman Chemistry		Pass	Non-Pass
	A, B %	C, D %	%	%
1 (Highest)	67	33	100	0
2	35	51	86	14
3	24	39	63	37
4 (Lowest)	2	45	47	53

This table indicates a notable scholastic superiority of the upper quarter, scholastic inferiority of the lowest quarter, and moderately successful accomplishment for those standing in the middle half of placement examination performance, this being the order of distribution usually desired in the several sections of a given class.

As to the advisability of the practice of sectioning classes, it may be said that experiments designed to test the value of this procedure accurately under controlled conditions are few; at the present time, the case for sectioning rests largely on the personal opinions of instructors who have worked with sectioned and unsectioned classes. The inquiry conducted by Dean C. E. Seashore for the American Association of University Professors * indicates a generally favorable attitude of instructors and administrators toward some plan of sectioning. Similarly, the authors in correspondence with users of the Placement Examinations have secured some subjective evidence of the effectiveness of sectioning, though the opinions were by no means unanimous.

* *Sectioning on the Basis of Ability*, by C. E. Seashore; A report by Committee G of the American Association of University Professors, Bulletin of American Association of University Professors, Volume IX, Number 6, October, 1923.

In a recent publication Professor James B. Tharp * of the University of Illinois reports the use of Placement Examinations in connection with courses in French. This study is one of the few trial experiments on the effects of sectioning and the value of the Placement Examinations in connection with that practice. Professor Tharp writes as follows:

"The experimental (*i.e.*, sectioned) classes gained the value of + 0.35, or about one-third of a letter grade over the non-sectioned classes. Moreover the 'middle-low' group has received a greater benefit from the division than the 'high' group since it gained + 0.64, nearly two-thirds of the letter grade. Opponents of sectioning have always claimed that average and poor students need the presence of their more brilliant fellows to inspire them to greater effort. This evidence indicates the exact opposite; that both groups are benefited by being separated and the less brilliant much more than the superior students."

The analysis of the utility of the Placement Examinations in individual personnel work is somewhat outside the scope of this bulletin, for the procedure of such work usually involves more or less elaborate case histories which are not amenable to brief summarizing. The ways in which the examinations are of use to personnel advisers are given in detail in the studies by Lemon † and by Remmers.‡ In these investigations the Placement Examinations gave specific information as to individual differences in ability along special lines of a type not available from a general intelligence test and were found serviceable in dealing with individuals.

Aptitude vs. Training. As will be readily appreciated, the division of the tests into two series, aptitude and training,

* *Sectioning Classes in Romance Languages*, by James B. Tharp; The Modern Language Journal, Volume XII, Number 2, November, 1927.

† Lemon, A. C. "An Experimental Study of Guidance and Placement of Freshmen in the Lowest Decile of the Iowa Qualifying Examination, 1925"; *University of Iowa Studies in Education*, Volume III, Number 8, February 1, 1927.

‡ Remmers, H. H. "A Diagnostic and Remedial Study of Potentially and Actually Failing Students at Purdue University," *Purdue University Studies in Higher Education* IX, May, 1928; 164 pp.

arose in part from the practical necessity of testing students who, though without previous schooling in a particular subject, such as chemistry or physics, nevertheless would enter upon the study of those subjects in college. Moreover it appeared desirable to differentiate the two types of ability in other subjects, such as mathematics and English, which all students present for admission, in order to improve the prediction obtainable by either type and to furnish for the college teacher information as to students possessing good general ability but poor preparation and also to point out those of good training but mediocre ability. There is, of course, a clear distinction between aptitude and training in all cases wherein a student may successfully undertake one test but not the other. Thus, a student without previous training in chemistry or physics will score approximately zero in the training tests on these subjects, but may secure high scores in the corresponding aptitude tests. Where both aptitude and training tests are given to students qualified to take both series a positive correlation between the results will be found but the correlation is not as high as that between different forms of the same aptitude or training examination. The correlation between aptitude and training tests varies from 0.54 to 0.58 while the reliability coefficients (to be explained later) range between 0.82 and 0.97. Thus while the tests do show positive correlation between the results on the aptitude and training examinations, the correlation is considerably less than that between forms of the same test, indicating that, to some degree, different qualities of the students are measured by the two examinations. It may also be pointed out that the aptitude test in a particular subject predicts performance in that subject better than it does in any other subject.

It may be asked, and properly, what grades of scholastic work are achieved by students having low scores on the aptitude tests and high scores on the training tests and by students making high aptitude scores and low training scores. A certain number of cases were selected for analysis and indicate the following, in general, the examinations being those in mathematics:

Of the students achieving high scores in both aptitude and training, about 55 per cent made A or B in freshman mathematics, slightly more than 40 per cent made C or D, and 4 per cent failed. No students who made low scores on both aptitude and training tests achieved A or B, 41 per cent achieved C or D, and 59 per cent failed. The students achieving low scores in the aptitude test and high scores in the training test were about equally divided among the three groups mentioned; about one-third in the A and B group, one third in the C and D group, and about one-third in the failing group. All the students who scored high in the aptitude but low in the training test were placed in the middle group of C and D grades in the freshman year—an indication of the handicap that the able student carries by reason of poor preparation. These results seem to be about what might have been anticipated of a valid test designed to measure aptitude and training separately and show in a general way that the tests performed their function properly. The number of cases analyzed for this illustration, however, is not large enough to warrant the drawing of any final conclusions and the data are not reproduced here in tabular form for that reason.

Reliability. Technically, the term reliability as applied to educational tests may be thought of as the consistency with which the test measures whatever it does measure. Reliability may be expressed quantitatively in two ways: (*a*) as a coefficient of correlation, and (*b*) as a probable error which shows the deviation of scores in the tests from hypothetical scores based on the mean of a very large number of cases. Since this bulletin is based only on Form A of the Placement Examinations, coefficients of reliability were computed by the so-called chance-half method. Reliability data for Series 1, Revised, Form A are given in the following table.

Name of Test	Coefficient of Correlation	Number of Cases	Standard Deviation (S.D.)	Probable Error of Score (PE_{score})	$\frac{PE_{score}}{S.D.}$
CA–1.....	0.88	100	17.5	4.0	0.23
CT–1.....	0.93	100	28.0	5.1	0.18
EA–1.....	0.82	100	9.2	2.6	0.29
ET–1.....	0.90	100	34.3	7.3	0.21
FA–1.....	0.97	100	26.7	3.1	0.11
FT–1.....	0.93	100	28.1	5.0	0.18
ST–1.....	0.82	100	16.7	4.8	0.29
MA–1.....	0.86	100	7.0	1.7	0.24
MT–1.....	0.88	100	10.4	2.4	0.23
PT–1.....	0.85	100	24.4	6.4	0.26
PA–1.....	0.89	100	19.0	4.2	0.22

The correlations listed above are typical of those usually found for examinations of the objective type. All computations are based on a single sample of beginning college students.

The standard deviation (S. D.) is the square root of the mean of the squares of deviations from the arithmetic mean of the scores.

The meaning of the probable error of score may be made clear by referring to the entry for Chemistry Aptitude CA–1. The value of 4.0 indicates that a score of say 60 is really a variable, such that fifty per cent of the time the score 60 will fall in the range 60 ± 4. Similarly since the scores follow a normal distribution the chances are 4.5 to 1 that the true score lies within the limits 60 ± 8; 21 to 1 that it lies within the limits 60 ± 12, etc. In this instance, then, it is reasonably certain that the score 60 could not under any changed conditions of sampling be less than 48 or more than 72.

Since the score units vary from test to test, the probable errors of score are not directly comparable measures of reliability but they are made comparable by the device of expressing each probable error and the corresponding standard deviation as a ratio; the smaller this ratio the more efficient the examinations.*

Comparison of Results of Placement Examinations in

* See Ruch and Stoddard, *Tests and Measurements in High School Instruction*, World Book Company (1927), Chapter XX.

Various Institutions. Greater differences of results in the Placement Examinations among various colleges are exhibited than might have been anticipated. This is true to a greater degree of the training than of the aptitude tests. Generally speaking, colleges in industrial and more thickly populated areas report higher scores on both parts of the tests than do colleges in rural sections. (It must be remembered, in this connection, that engineering colleges draw their students from areas quite close to the institutions, the median radius being about one hundred miles. See Bulletin Number 1 of the Investigation of Engineering Education.) Presumably students in the more thickly populated sections of the country received their preparation in the larger and better equipped and better staffed public schools of the cities, whereas students, from rural communities come from the less well equipped rural schools. In the examinations in mathematics the five institutions reporting the highest median scores are in industrial sections, whereas the five reporting the lowest scores are all in non-industrial localities, and all but one of these are in the South. The range of median scores reported by the colleges is considerable in all of the examinations but is greatest in the sciences, physics and chemistry. This is to be expected, since it is in these subjects that the laboratory facilities that are needed for effective work are often lacking in the smaller schools.

Of greatest significance to engineering colleges, probably, are the results in mathematics. In the aptitude test the median scores reported range from a maximum of 39.36 to a minimum of 19.16. In the training test the range is from 51.50 to 24.08. In both cases this is approximately a ratio of two to one.

In other subjects the range of median scores is even greater as indicated by the following tabulation which includes only those institutions that administered the tests to students of engineering:

Examination	Highest Median Score	Lowest Median Score	Approximate Ratio
Chemistry Aptitude.....	79.46	40.28	2 : 1
Chemistry Training.....	99.15	39.05	2.5 : 1
English Aptitude.....	47.93	32.09	1.5 : 1
English Training.....	109.95	59.50	1.85 : 1
Mathematics Aptitude.....	39.36	19.16	2 : 1
Mathematics Training.....	51.50	24.08	2 : 1
Physics Aptitude.....	142.34	108.07	1.3 : 1
Physics Training.....	91.09	36.00	2.5 : 1

(The number of institutions administering the foreign language tests to engineering students was so small as to make statements of maximum and minimum scores misleading.)

In a discussion of the results of the Placement Examinations in chemistry, Cornog and Stoddard * say as to this situation: "In a general way the scores (in the Aptitude Test) represent the native capacity of the freshman groups at the institutions named to accomplish whatever is required of them in the pursuit of a first course in freshman chemistry. A notable feature of this table is the rather narrow limits between which the mean scores fluctuate. East, West, country or city, large institution or small—the student in the middle of the class most often makes a score not varying widely from 60. This indicates that freshman chemical aptitude is much the same everywhere and that no college represented has a notable initial handicap or advantage in the quality of its starting material.†

"Similarly Table V contains mean scores (This table, Number 5 of this bulletin, with additional institutions not reported upon by Cornog and Stoddard will be found in the Appendix,

*"Predicting Performance in Chemistry;" *Journal of Chemical Education*, Volume 3, No. 12, December, 1926.

† In the above table it appears that the ratio of highest to lowest median scores reported by the colleges for the Chemistry Aptitude Test is approximately 2:1. This ratio would be reduced to approximately 1.7:1 by the omission of the results from one institution. The inferences drawn by Cornog and Stoddard as to the range of aptitude in chemistry among freshmen is warranted by a more detailed study of the data than is afforded by the mere statement of the ratio of highest to lowest median score. Ed.

page 72) obtained from the use of the Chemistry Training Examination at the institutions mentioned in the table.

"Table V affords an index of the thoroughness of the chemical training given by high schools to the students in the various groups represented.

"A study of Table V reveals the fact that, in any column in the table representing average group scores, the highest value is just about double the lowest. Further observation shows that the average score of the lowest fourth at some institutions is higher than the average score of the highest fourth at others. No merit or lack of it on this account applies to the institutions concerned, since the thing measured is retention of chemistry learned in high school before coming to college. Whatever may be the causes of the conditions indicated, the fact remains that the problem of utilization of high school chemistry as a basis for a differentiated freshman chemistry course will be a very different problem at different institutions. Further, the spread of scores in single institutions is such as to raise the question of the advisability of giving the same course to all who offer entrance credit in chemistry."

Continuing the above argument it is fair to ask, in view of the divergence of results shown by various institutions and by the range of scores among their students, whether it is sound practice to place all of these students in college courses at the same starting level, especially in mathematics and the physical sciences. The evidence indicates that there is a considerable range of quality and extent of preparation among institutions and, as before stated, among students in the same institution. Presumably, and the presumption may be supported by evidence, many of the poorly prepared students possess good native ability as well as traits of perseverance making for success in college work. Started at the right level and carried along at a pace they are capable of sustaining, such students may go far. Forced to adhere to a general standard beginning level and to carry the same work as those better prepared, such students may, and do, become discouraged, lag behind, and eventually drop out of college under the stigma

of failure. The question of organization of freshman classes is beyond the scope of this bulletin, excepting only as the results of the Placement Examinations have a bearing upon it, and will not be discussed further. The problem is a very important one, however, and the above facts, as well as others to be deduced from the tabulations of data, are presented for whatever light they may throw upon the situation.

Table 5 (Appendix, page 72) summarizes data on the results of the Placement Examinations reported by all the colleges offering engineering courses.

Quality of Students' Preparation as Indicated by Results of Placement Examinations. The results of this study afford quite a little information upon the question of the extent and quality of the preparation of students entering engineering colleges throughout the country. It is the intention to discuss this phase of the results, one of the important reasons for undertaking the project. Since the figures speak plainly for themselves, comment will be relatively brief.

The following tabulations give the number of correct and incorrect answers and the number of times omitted for selected questions of the training examinations in three subjects—mathematics, chemistry and physics. The questions were selected, in general, because they are typical and because in many instances they deal with fundamental concepts, laws or processes which are believed to be essential as basic preparation for the successful pursuit of the subject. Only comparatively simple questions were selected; those that seemed more difficult were omitted. In general the questions selected were distributed fairly evenly throughout the several tests. The number of times the answer to any particular question was omitted is, of course, influenced to a certain degree by the position of the question in the whole group; those occurring toward the end would naturally be omitted oftener than those occurring near the beginning. It is believed that this element has been guarded against properly in selecting the questions. It should be remembered that the institutions represented in the summaries are located in all parts of the country, that they include all types of colleges offering engineering courses, and

that there is a fair division between institutions in urban and in rural communities. The figures, of course, represent average conditions; there are fairly striking deviations from the average.

SELECTED QUESTIONS FROM MATHEMATICS TRAINING, MT–1

	Right	Wrong	Omitted	Total	% right
1/8 plus 5/8 equals how many hundredths?	1,005	425	104	1,534	65.6
Divide 8/15 by 3.2	637	348	549	1,534	48.0
Simplify: $\frac{3.12}{\sqrt{.04}}$	343	434	754	1,531	22.5
Perform the multiplication $(a^2bc^4)^3$	968	414	142	1,524	63.5
Add: $\frac{1}{a}+\frac{1}{b}$	822	629	83	1,534	53.6
The lateral area of a circular cylinder is approximately 3.1416 times the altitude (to be marked *true* or *false*)	972	450	112	1,534	63.4
The perimeter of a square is $4y$. What is the diagonal?	648	683	203	1,534	42.3
Write a formula which gives the cost c in dollars of m miles of wire at d dollars a pound, if one foot of wire weighs p pounds	464	714	356	1,534	30.2
The quotient of two numbers, x and y, is 2, and the larger exceeds the smaller by 7. Find the numbers. (Equations only)	299	285	950	1,534	19.5

On this examination (Mathematics Training), for which a perfect score is 75, the median score of 1534 students was approximately 37.5, or 50 per cent, stated in the usual manner of grading. The highest median score reported by an institution was approximately 50, and the lowest approximately 25. The maximum score reported for any individual student was 70.

The following illustrations are typical of the results in chemistry:

	Right	Wrong	Omitted	Total	% right
Nitrogen is a very active element. (To be marked *true* or *false*)	353	149	27	529	66.7
Anhydrides are a group of minerals. (To be marked *true* or *false*)	388	57	84	529	73.4
Write the valence of SO_4	251	47	231	529	47.5
Write the formula for copper sulphate	373	82	74	529	70.5
Write the formula for lime (unslacked)	121	179	229	529	22.8
Complete and balance $KOH + HCl$	365	44	120	529	69.0
Complete and balance $2Al(OH)_3 + 3H_2SO_4$	89	187	252	528	16.8
If 7 gm. of iron unite with 4 gm. of sulphur, how many gm. of iron sulphide will be produced?	363	57	109	529	68.6
The atomic weight of H is 1; of Cl, 35.5; of Zn, 65. What weight of Zn will be needed to generate 10 gm. of H, using dilute HCl?	89	114	326	529	39.2

Commenting on the results of this examination, Cornog and Stoddard (See reference on page 50) say: "In a group where 31 per cent fail to complete and balance $KOH + HCl$ . . . we believe we are warranted in assuming that a third of the group learned nothing of equation writing or chemical arithmetic while in high school.* High school chemistry teachers may find comfort in the fact that if many freshmen got through high school without knowing much about chemical arithmetic, there was also a large number who got through without knowing much about *any* arithmetic as is evidenced by data gathered from the Mathematics Training Examination."

In physics the results are even more striking and, we are impelled to say, discouraging. Consider the following tabulation giving results on typical questions of the Training Examination. All of the 534 students taking this examination had had physics in high school.

* In view of results on other questions, this seems to be a very conservative statement as to the percentage not having the ability named. Ed.

	Right	Wrong	Omitted	Total	% right
—— is the rate of doing work	130	216	188	534	24.4
The heat developed in a conductor is proportional to the —— of the current	53	274	207	534	10.0
The intensity of light is inversely proportional to the square of the distance between the source of light and the illuminated object. (*True* or *false*)	247	231	56	534	44.8
The fall of potential along a conductor is inversely proportional to its resistance. (*True* or *false*)	116	185	233	534	21.8
In Boyle's Law, PV = ——	251	119	164	534	47.0
In Ohm's Law, I = ——	157	109	268	534	29.4
If 10 divisions on a vernier cover 9 mm. on a millimeter scale, the smallest division that can be measured is (in mm.)	88	253	193	534	16.5
A body submerged in a liquid is buoyed up by a force equal to the weight of the liquid displaced by it. (Name of the law to be stated)	204	72	258	534	38.2

One may ask, in view of the above results, which are typical of those throughout the examinations: What *do* students learn of physics in the high school? If they do not, at the very least, know the statement of Ohm's Law, to say nothing of its use, what *do* they know of electricity and magnetism? If they cannot tell how a simple vernier is read, what *do* they know of physical measurements? If they do not know that power is the rate of doing work, what *do* they know of mechanics? The answer, we fear, is that the college teacher of physics cannot assume any beginning knowledge on the part of most of his class. As a matter of fact, this is the actual case in most institutions, and the teaching of physics to engineering students is adjusted accordingly. But the question remains: What did the student do with his year's work in physics in the high school? Has he any mastery of what he

has covered; does he have any conception of quantitative relations; has he had any discipline in thinking intensively about the materials that he has had placed before him by his teachers? The answers to these questions are of vital interest to engineering teachers.

No one would claim, of course, that the results of a single examination can give an accurate picture of the values of secondary education in this country. But they can and do throw some light upon the causes of the difficulties with which teachers of engineering freshmen and sophomores are struggling. For better or worse the colleges of engineering are bound to depend upon the high schools for their recruits. Is it not fair to ask whether the work of the high schools should, to a reasonable degree, be designed to lay the foundation for the work that the student must carry on in college? Do the results of this study as cited above indicate that such is the case?

Sectioning of Classes on the Basis of Ability. Quite a little has been said in the preceding paragraphs concerning this matter and it may now be well to summarize those aspects of sectioning upon which the placement examinations have a bearing. The case for sectioning appears to rest in principle upon answers to the following questions:

(1) Is there sufficient heterogeneity in the class to justify the establishment of sections of students of different grades of ability and preparation?
(2) Can a sufficiently accurate means of measuring differences among individual students be found?
(3) Will the students benefit by the practice; will the superior, the average and the weaker students all benefit?

If sectioning on the basis of ability be established as desirable in principle certain other questions which present themselves when the practice is to be instituted must also be answered:

(4) What are the administrative difficulties and how can they be met? (Such questions as scheduling the class hours in various subjects; provision for promoting and

demoting students during the semester so as to insure proper placement, and the like.)

(5) What is the best number of sections; shall there be a superior group, a middle group and a low standing group, or shall there be more or fewer classifications?

(6) Should students be sectioned for each subject according to probability of success in it or will a single sectioning for all subjects in a given semester be sufficient?

(7) What different ways of dealing with the several sections should be employed; in particular, if the superior students are to be given greater opportunity shall this take the direction of more ground to be covered or shall the same ground be covered in a different way?

(8) How shall the teachers be assigned to the several sections; should the ablest take the best or the poorest sections?

(9) Should there be a minimum standard of performance and a minimum requirement of material to be covered by all students irrespective of the section in which they are placed or should the standards be adjusted, more or less, to accord with the capabilities of the different sections?

These questions do not exhaust the possibilities among those that might be asked here but they indicate the sort that arise when the practice is under consideration either in principle or from the standpoint of the everyday working of the institution.

As to the first question above, we believe that the experience of teachers, as well as the evidence adduced herein prove that college students, particularly freshmen, are of such a wide range of abilities and preparations as fully to warrant the establishment of sections of different grades of ability. This is undoubtedly true, though perhaps not to the same degree, of students in institutions of all kinds, not only the publicly supported university that must by legal enactment admit all graduates of accredited high schools, but also of the privately endowed college which exercises more or less discrimination in admitting candidates. Further, it is true, as demonstrated by the data of this study, even of institutions admitting comparatively small classes. In brief, there can be no reasonable

doubt as to the validity of sectioning if it rest on the basis of heterogeneity of students only.

As to the discovery of instruments for differentiating students, we believe that those which predict scholastic achievement in particular subjects serve the purpose to better advantage than those designed to measure academic success in general in view of the way in which college work is conducted. The extent to which the Iowa Placement Examinations serve as valid measuring instruments is stated in the preceding paragraphs. For subjects of the second semester of the freshman year or for those of later years the grades in preceding semesters in the same or related subjects may be employed even though under the traditional methods of grading the grades are relatively inaccurate. Examinations of the objective type administered at time of admission will not measure, except indirectly, such important points as personality traits, environment, health and other factors, but these are included in considerable measure in semester grades. To summarize, we feel justified in saying that if classes are to be sectioned, means of doing so in a satisfactory manner are now available.

Of course the final answer to the question of sectioning depends upon the benefits which the practice brings to students and teachers. A considerable amount of subjective evidence in the form of opinions by teachers who have followed the practice of sectioning is available and it is, in general, favorable. The experimental work reported by Miller,* Tharp (19)†, Young (20), and Cornog (2) are more objective measures of the results of sectioning. The results obtained by Tharp have already been quoted in this bulletin (see page 54) and the reader is referred to the other references in case he wishes to examine further into the matter. So far as the evidence warrants us in drawing conclusions it may be said

* Miller, H. W. (University of Michigan), "Segregation on the Basis of Ability." *School and Society*, Volume XXVI, Number 655 (July 16, 1927), pages 84–88; (July 23, 1927), pages 114–120.

† Figures in parentheses refer to item numbers of the Bibliography (Appendix, page 77).

that all sections of a class benefit from sectioning; the superior, the average and the weak students alike.

That the administrative difficulties connected with sectioning can be surmounted in almost all instances is clearly indicated by the rapid spread of the practice among the colleges in the past few years.

Limitations of Placement Examinations. Some of the limiting factors in the employment of the Placement Examinations for the ends which have been advanced previously in this study are already implicit in the discussion. They may be summarized at this point as a means of checking too great expectations and in order to suggest further supplementary lines of investigation.

(1) The examinations are brief (each test comprises about 40 minutes' working time) and they are imperfect. Hence where important decisions regarding individuals are involved it will be best to give both forms, A and B. This doubles the testing time, and increases the reliability as shown in Table 6 (Appendix, page 76). Where time is not a prime factor (e.g. in building up an elaborate case history) the best procedure is to give the student both forms of every examination which has any bearing on his case.

(2) The examinations measure certain important traits of character and personality only in an incidental manner. Thus persistence is a differentiating influence between scholastic success and failure. Similarly interest in the work, drive, resistance to outside distracting influences, emotional stability, methods of study, etc., while they are not names of specific traits, nevertheless connote behavior patterns which have varying weight in determining actual achievement. They are measured by the Placement Examinations only to the extent that performance in these is somewhat conditioned by the operation of such factors during both the learning period (that is to say in high school or preparatory school) and the testing period. Of especial interest here is the finding of May * that

* May, Mark A., "Predicting Academic Success." *Journal of Educational Psychology*, Vol. XIV, No. 7 (October, 1923), pages 429–440.

prediction of college success by means of an intelligence examination was significantly increased by taking into account the amount of time devoted to study. The fact that the most intelligent tended to study less than the others lowered the observed correlation between test-scores and college achievement. Hence administrators and counselors interested in securing optimum prediction of success during the first few days or weeks of college attendance must be prepared to embark upon a rather extensive investigation of the complete personality of individual students, together with a careful study of the new scholastic milieu in which they are to be active. At best there will be sufficient departure from predicted results to prevent monotony and forestall any strictures as to the deterministic nature of the program! Moreover as has been pointed out by Brigham * and by Stoddard (16, page 26) to the extent that early remedial measures (such as elimination, sectioning, counseling) are applied, we may expect a decrease in the correlations representing such prognosis.

(3) Human achievement in any field is in part the resultant of forces which operate in a fickle and temporary fashion. Measurement in September, no matter how perfect it may become, cannot take complete account of conditions and forces which intervene in the life of the student between September and January—some of these influences (such as illness, accident, financial loss) are simply not in the individual or environmental pattern at the beginning.

(4) Finally the college marks which are taken to represent achievement are not themselves very reliable. As a result, when the Placement Examinations are used to predict scores in comprehensive, objective semester examinations in a subject, the correlations are noticeably increased—see, for example, Stoddard (16) and Tharp (19). Similarly a satisfactory prediction of pooled academic grades is a less difficult problem than prediction of grades in a particular subject. Improvement here must come through the utilization of better

* Brigham, C. C. (Chn.). *Scholastic Aptitude Tests*—Manual; page 8.

achievement examinations in conjunction with the adoption of a more uniform policy of marking on the part of instructors.

Conclusion. It may be well in this concluding section briefly to summarize some of the more important conclusions drawn on the preceding pages.

One of the facts that the results of the study indicate clearly is the great range of aptitude and preparation possessed by entering students, both for scholastic work in general and for specific subjects in particular. All thoughtful teachers realize this, of course, but educational practice all too often fails to provide for it and to adjust the starting level of college courses and the pace maintained in them to accord with student capacities.

Another factor indicated by the data, one that might not have been anticipated by some, is the considerable range of median scores on the examinations reported by various institutions. This range is greater in the case of the Training Tests than in the Aptitude Tests, but it is significant in both.

The Placement Examinations appear to be valid instruments for the prediction of scholastic achievement in college. The prediction appears to be best among the highest ranking students, good as to the lowest ranking students, and, as might have been expected, lowest as to the students near the middle of the group. Since it is the ablest and the poorest students whom it is usually desired to differentiate, the examinations appear to serve their purposes as means of predicting college work adequately. While not primarily intended to serve as means of predicting work beyond the freshman year, the results reported by institutions which supplied information indicate good prediction of student survival throughout the undergraduate course. We surmise that this prediction is best where factors extraneous to scholarship are least operative.

From the evidence adduced it appears that the Placement Examinations furnish valid data for the sectioning of classes on the basis of ability. Such data are also valuable as parts

of case histories in institutions which provide some form of individual personnel work.

The results of the examinations appear to throw considerable light upon the much mooted question as to the quality and extent of the scholastic preparation of students entering upon the study of engineering. If the situation can be summed up in a phrase, it may be said that the instructor of freshmen and sophomores can take nothing for granted in dealing with the fundamentals of his subjects.

While no attempt has been made fully to discuss the matter of sectioning on the basis of ability, the evidence cited is generally favorable to that practice. From the few controlled experimental studies that have been made of its results it appears that all students benefit, the poorest even more than the ablest. In connection with the practice of sectioning, one point not previously discussed may be mentioned. In many, in fact probably in most, institutions which do not require entering students to present credentials in physics and chemistry those who have pursued the subject in high school (and in the case of some urban high schools have had excellent preparatory training in them) are placed in the same sections with students who have had no preparation in them at all. The pace of the class, which is no doubt adjusted to the abilities of a majority of the group, is therefore entirely unsuited to those of good preparation and in many instances is equally unsuited to those of no preparation and of low aptitude. The result is no doubt equally bad both for the best and for the poorest students. Sectioning in accordance with preparation and aptitude appears to offer the remedy for this situation.

As a final word the authors would reiterate a statement previously made: that the results of tests such as the Placement Examinations, valuable as they may be simply as data, cannot by themselves accomplish anything. It is only when they are *used* for remedial measures that good can result.

APPENDIX

TABLE 1.

SUMMARY OF CONTENT OF THE TRAINING AND APTITUDE TESTS

CHEMISTRY APTITUDE, CA–1 (125 items, 44 minutes).

Part 1. (20 items, 15 minutes.) Simple arithmetical relations which appear in chemistry.

Part 2. (30 items, 12 minutes.) Three paragraphs are presented covering college textbook material in chemistry, followed by precise questions which measure the student's ability to read exactly and to resist generalizations.

Part 3. (15 items, 12 minutes.) A measure of chemistry reading comprehension which, for correct answers, requires a grasp of the ideas and relations involved.

Part 4. (60 items, 5 minutes.) Interest in chemistry is measured by simple factual questions of the true-false type which indicate the accuracy of the student's general knowledge of chemistry. Students with a particular fitness and liking for chemistry acquire this knowledge incidentally.

CHEMISTRY TRAINING, CT–1 (152 items, 43 minutes).

Part 1. (45 items, 8 minutes.) Knowledge of fundamentals of chemical processes.

Part 2. (45 items, 12 minutes.) Covers valencies, formulas, names of compounds, and the completion and balancing of equations.

Part 3. (50 items, 8 minutes.) Manufacturing processes and the applications of chemistry.

Part 4. (12 items, 15 minutes.) Fundamental chemical problems in which the mechanics of arithmetic are reduced to a minimum.

ENGLISH APTITUDE, EA–1 (65 items, 43 minutes).

Part 1. (20 items, 8 minutes.) Measures ability to comprehend and apply rules of grammar.

Part 2. (10 items, 8 minutes.) Measures ability to grasp compact material of the type found in college textbooks.

Part 3. (15 items, 12 minutes.) A measure of reading comprehension, with the emphasis placed on ideas rather than factual content.

Part 4. (20 items, 15 minutes.) Tests composition ability, through accuracy of analysis of a theme.

ENGLISH TRAINING, ET–1 (190 items, 40 minutes).

Part 1. (25 items, 8 minutes.) Twenty-five misspelled words are presented in a list of seventy-five words drawn from Standardized Spelling Scales.

Part 2. (60 items, 11 minutes.) A test of punctuation and sentence structure through recognition of right and wrong sentences.

Part 3. (60 items, 11 minutes.) A test of grammar with special reference to colloquialisms, barbarisms, and common errors of oral English.

Part 4. (45 items, 10 minutes.) A measure of the student's ability to distinguish between clear, emphatic sentences and those which are weak, confused or ridiculous.

FOREIGN LANGUAGE APTITUDE, FA–1 (150 items, 45 minutes).

Part 1. (50 items, 10 minutes.) A brief measure of elements of English grammar which deal with parts of speech, inflections, and roots.

Part 2. (40 items, 12 minutes.) Esperanto is employed to measure the amount of transfer from English to an unfamiliar language. Success in recognizing the significant words in the Esperanto sentences depends on the ability to grasp the meaning of the whole sentence.

Part 3. (30 items, 10 minutes.) Tests the ability to comprehend and apply grammar rules in an unfamiliar language (Esperanto).

Part 4. (30 items, 13 minutes.) A measure of aptitude for translation. The student observes a scrambled English translation of material in Esperanto and is asked for English equivalents, Esperanto equivalents, and parts of speech.

FRENCH TRAINING, FT–1 (160 items, 45 minutes).

Part 1. (60 items, 10 minutes.) A vocabulary test based on Henmon's word count.

Part 2. (40 items, 10 minutes.) Covers essential points in French grammar.

Part 3. (40 items, 10 minutes.) A test of important idioms and tenses of verbs.

Part 4. (20 items, 15 minutes.) A measure of French reading comprehension, in which three paragraphs of increasing difficulty are presented followed by questions to be answered in English.

SPANISH TRAINING, ST–1 (150 items, 43 minutes).

Part 1. (50 items, 8 minutes.) A vocabulary test based on Henmon's word count.

Part 2. (40 items, 10 minutes.) A test of the fundamentals of Spanish grammar.

Part 3. (40 items, 10 minutes.) A test of verb forms and usages.

Part 4. (20 items, 15 minutes.) A measure of Spanish reading comprehension employing three graded paragraphs and questions in English.

MATHEMATICS APTITUDE, MA–1 (65 items, 40 minutes).

Part 1. (15 items, 5 minutes.) Consists of arithmetic and algebraic number series similar to those commonly found in intelligence tests.

Part 2. (15 items, 10 minutes.) Primarily a test of constructive imagination. Solution of the problems depends upon the student's ability to visualize geometric figures and to see the relations involved.

Part 3. (20 items, 10 minutes.) This is a test of logic. It measures ability to symbolize and to comprehend abstract relations.

Part 4. (15 items, 15 minutes.) A measure of mathematical reading comprehension. The material (calculus) is unfamiliar to the student, and correct answers call for a grasp of relations and principles.

MATHEMATICS TRAINING, MT–1 (95 items, 40 minutes).

Part 1. (20 items, 10 minutes.) A test of the fundamentals of arithmetic, each item representing a different small skill.

Part 2. (20 items, 10 minutes.) Covers frequently encountered operations in formal algebra.

Part 3. (40 items, 10 minutes.) Basic information in geometry, together with operations which often require that the student draw a figure to obtain the correct solution.

Part 4. (15 items, 10 minutes.) Algebraic reasoning problems in which mechanical computation is reduced to a minimum.

PHYSICS APTITUDE, PA–1 (125 items, 45 minutes).

Part 1. (25 items, 13 minutes.) A test of the arithmetical relations in elementary physics.

Part 2. (30 items, 15 minutes.) Paragraphs representing college textbook material in physics are followed by a series of questions which test the student's grasp of the material.

Part 3. (20 items, 10 minutes.) A test comprising number series completion and symbolic logic.

Part 4. (50 items, 7 minutes.) A test of interest in physics as determined from the student's fund of common knowledge of the subject.

PHYSICS TRAINING, PT–1 (125 items, 43 minutes).

Part 1. (40 items, 10 minutes.) A completion test of fundamental information in physics.

Part 2. (50 items, 8 minutes.) A true-false test of additional fundamental information and principles in physics.

Part 3. (20 items, 8 minutes.) Comprises the completion of physical equations and a test of knowledge of important principles.

Part 4. (15 items, 17 minutes.) A measure of the student's ability to solve fundamental problems. Arithmetical computation has been reduced to a minimum.

TABLE 2

FREQUENCY DISTRIBUTIONS OF SCORES IN IOWA PLACEMENT EXAMINATIONS

(The figures in the columns headed *F* indicate the numbers of students whose scores fell within the corresponding score groups in the adjacent columns. The letter *N* signifies the total number of cases.)

Chemistry Aptitude		Chemistry Training		English Aptitude		English Training	
Scores	F	Scores	F	Scores	F	Scores	F
0–2	5	0–9	35	3–7	2	0–9	10
3–7	22	10–19	79	8–12	15	10–19	41
8–12	54	20–29	117	13–17	69	20–29	96
13–17	119	30–39	123	18–22	243	30–39	300
18–22	206	40–49	167	23–27	563	40–49	454
23–27	249	50–59	186	28–32	1,011	50–59	606
28–32	380	60–69	167	33–37	1,526	60–69	602
33–37	421	70–79	187	38–42	1,684	70–79	666
38–42	485	80–89	166	43–47	1,599	80–89	667
43–47	525	90–99	139	48–52	1,118	90–99	667
48–52	449	100–109	116	53–57	570	100–109	659
53–57	519	110–119	88	58–62	171	110–119	655
58–62	408	120–129	61	63–67	12	120–129	596
63–67	483	130–139	42			130–139	479
68–72	407	140–149	22			140–149	408
73–77	335	150–159	18			150–159	302
78–82	303	160–169	2			160–169	199
83–87	229	170–179	1			170–179	107
88–92	164					180–189	44
93–97	91					190–199	7
98–102	54					200–209	1
103–107	6						
108–112	2						
113–117	1						
N = 5,917		N = 1,716		N = 8,583		N = 7,566	

TABLE 2 (*Continued*)

Mathematics Aptitude		Mathematics Training		Physics Aptitude		Physics Training	
Scores	F	Scores	F	Scores	F	Scores	F
0–2	21	0–2	11	20–29	4	0–9	26
3–7	155	3–7	71	30–39	7	10–19	38
8–12	412	8–12	152	40–49	27	20–29	75
13–17	734	13–17	282	50–59	52	30–39	93
18–22	787	18–22	415	60–69	116	40–49	130
23–27	915	23–27	589	70–79	150	50–59	147
28–32	837	28–32	613	80–89	256	60–69	137
33–37	665	33–37	610	90–99	266	70–79	142
38–42	446	38–42	525	100–109	324	80–89	134
43–47	266	43–47	467	110–119	372	90–99	118
48–52	148	48–52	326	120–129	397	100–109	98
53–57	60	53–57	216	130–139	468	110–119	60
58–62	13	58–62	112	140–149	382	120–129	37
63–67	1	63–67	41	150–159	245	130–139	24
		68–72	7	160–169	58	140–149	11
				170–179	2	150–159	4
N = 5,460		N = 4,437		N = 3,126		N = 1,274	

TABLE 2 (*Continued*)

Foreign Language Aptitude		French Training		Spanish Training	
Scores	F	Scores	F	Scores	F
0–9	2	0–9	1	3–7	2
10–19	5	10–19	20	8–12	0
20–29	49	20–29	44	13–17	10
30–39	82	30–39	91	18–22	14
40–49	141	40–49	71	23–27	24
50–59	188	50–59	85	28–32	30
60–69	240	60–69	90	33–37	45
70–79	255	70–79	69	38–42	44
80–89	215	80–89	44	43–47	25
90–99	211	90–99	45	48–52	30
100–109	152	100–109	34	53–57	19
110–119	147	110–119	29	58–62	17
120–129	67	120–129	26	63–67	14
130–139	33	130–139	14	68–72	10
140–149	3	140–149	13	73–77	10
		150–159	1	78–82	7
				83–87	0
				88–92	2
				93–97	0
				98–102	3
N = 1,790		N = 677		N = 306	

TABLE 3

GRADES ACHIEVED IN FRESHMAN SUBJECTS BY STUDENTS PLACING IN EACH FOURTH OF THE GROUP IN PLACEMENT EXAMINATIONS SCORES

(All figures given in the table are percentages)

Chemistry Aptitude + Chemistry Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	67	33	100	0
2	35	51	86	14
3	24	39	63	37
4	2	45	47	53

English Aptitude + English Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	50	42	92	8
2	37	48	85	15
3	24	59	83	17
4	8	58	66	34

Foreign Language Aptitude + French Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	55	45	100	0
2	25	60	85	15
3	14	67	81	19
4	31	38	69	31

Mathematics Aptitude + Mathematics Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	51	44	95	5
2	29	61	90	10
3	10	76	86	14
4	1	59	60	40

Chemistry Aptitude

Quarter	A, B	C, D	Total Pass	Non-Pass
1	51	45	96	4
2	30	56	86	14
3	22	54	76	24
4	10	55	65	35

TABLE 3. *Continued*

Chemistry Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	66	33	99	1
2	31	62	93	7
3	23	50	73	27
4	20	52	72	28

English Aptitude

Quarter	A, B	C, D	Total Pass	Non-Pass
1	44	46	90	10
2	25	59	84	16
3	16	62	78	22
4	8	55	63	37

English Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	53	43	96	4
2	29	60	89	11
3	17	63	80	10
4	4	53	57	43

Foreign Language Aptitude

Quarter	A, B	C, D	Total Pass	Non-Pass
1	55	35	90	10
2	29	59	88	12
3	25	50	75	25
4	19	44	63	37

French Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	48	52	100	0
2	34	52	86	14
3	21	68	89	11
4	38	33	71	29

TABLE 3. *Continued*

Mathematics Aptitude

Quarter	A, B	C, D	Total Pass	Non-Pass
1	47	48	95	5
2	27	55	82	18
3	11	63	74	26
4	4	53	57	43

Mathematics Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	50	44	94	6
2	29	59	88	12
3	12	61	73	27
4	5	50	55	45

Physics Aptitude

Quarter	A, B	C, D	Total Pass	Non-Pass
1	49	49	98	2
2	16	68	84	16
3	10	68	78	22
4	16	44	60	40

Physics Training

Quarter	A, B	C, D	Total Pass	Non-Pass
1	32	65	97	3
2	6	78	84	16
3	3	65	68	32
4	0	42	42	58

TABLE 4

PREDICTION BY INTELLIGENCE TESTS OF FIRST SEMESTER GRADE *AVERAGES* (ALL SUBJECTS) IN COLLEGE

Name of Test	r	Source
Army Alpha	.45	Stone (1922)
Army Alpha	.44	Stone (1922)
Army Alpha	.33	Stone (1922)
Army Alpha	.50	Stone (1922)
Army Alpha	.41	De Camp (1921)
Army Alpha	.49	Stoddard (1925)
Army Alpha	.44	MacPhail (1924)
Army Alpha	.45	Colvin (1919)
Thorndike I–III	.60	Thorndike (1922)
Thorndike I	.47	Thorndike (1922)
Thorndike II	.45	Thorndike (1922)
Thorndike I–III	.51	Wood (1923)
Thorndike	.53	MacPhail (1924)
Thorndike	.41	MacPhail (1924)
Thorndike	.41	MacPhail (1924)
Thorndike	.41	MacPhail (1924)
Council on Education	.62	Stoddard (1925)
Council on Education	.54	Thurstone (1925)
Thurstone	.13	Hoke (1922)
Thurstone	.29	Thurstone (1922)
Minnesota	.63	Johnston (1924)
Terman Group	.48	Hoke (1922)
Brown University	.46	MacPhail (1924)
Brown University	.38	MacPhail (1924)
Brown University	.39	MacPhail (1924)
Brown University	.37	MacPhail (1924)
University of Texas	.49	Perrin (1924)
Iowa Placement Examinations	.65 to .75	Stoddard (1926)

PREDICTION BY INTELLIGENCE TESTS OF FIRST SEMESTER GRADES IN SPECIFIC SUBJECTS IN COLLEGE

Name of Test	r	Source
University of Texas (Chemistry)	.30	Perrin (1924)
Thorndike I (Chemistry)	.27	Stoddard (1925)
Thorndike I (Chemistry)	.41	Stoddard (1925)
University of Texas (English)	.54	Perrin (1924)
Thorndike I (English)	.42	Stoddard (1925)
Thorndike I (English)	.36	Stoddard (1925)
University of Texas (Mathematics)	.36	Perrin (1924)
Thorndike I (Mathematics)	.23	Stoddard (1925)

TABLE 4. *Continued*

Thorndike I (Mathematics)	.17	Stoddard (1925)
University of Texas (Physics)	.31	Perrin (1924)
University of Texas (Romance Language)	.41	Perrin (1924)
Thorndike I (Romance Language)	.25	Stoddard (1925)
Thorndike I (Romance Language)	.18	Stoddard (1925)
Iowa Placement Examinations:		
Chemistry Aptitude	.48	
Chemistry Training	.52	
Chemistry Aptitude plus Chemistry Training	.52	
English Aptitude	.46	
English Training	.54	
English Aptitude plus English Training	.52	
Foreign Language Aptitude	.52	
French Training	.56	
Spanish Training	.53	
Mathematics Aptitude	.46	
Mathematics Training	.51	
Mathematics Aptitude plus Mathematics Training	.51	
Physics Aptitude	.47	
Physics Training	.61	

TABLE 5

RANGE OF SCORES IN PLACEMENT EXAMINATIONS REPORTED BY COLLEGES ADMINISTERING THE EXAMINATIONS TO ENGINEERING STUDENTS

CHEMISTRY APTITUDE, CA–1, REVISED

Name of College	Date Given	Number	Mean	Median	Upper Quartile	Lower Quartile
U. of California	October	640	65.42	67.22	78.16	54.08
Case School of Applied Science	September 23	182	73.74	76.59	84.82	64.41
U. of Cincinnati	November 9	76	39.08	40.28	45.18	34.33
U. of Iowa	September	356	47.46	46.79	58.59	34.92
Kansas State Agric. College	October 1	85	59.78	60.46	71.38	44.75
U. of Minnesota	September 26	335	67.42	68.58	78.94	56.58
Missouri School of Mines	September 18	124	58.87	60.92	69.17	48.06
Montana State College	September 24	116	64.48	64.00	73.13	55.58
U. of N. Carolina	October 19	70	63.00	64.64	76.72	48.33
U. of Oregon	October 9	189	55.10	53.38	69.66	43.01
Rutgers Univ.	October 31	65	77.31	79.46	87.84	67.66
U. of Washington	October 2	144	70.28	71.20	85.50	60.40

TABLE 5. *Continued*

CHEMISTRY TRAINING, CT–1, REVISED

Name of College	Date Given	Number	Mean	Median	Upper Quartile	Lower Quartile
Poly. Inst. of Brooklyn	September 21	61	84.50	79.08	99.19	64.14
Case School of Applied Science	September 23	182	89.28	89.96	114.50	63.11
U. of Cincinnati	November 9	77	94.36	99.15	119.15	79.05
U. of Iowa	September	77	54.73	49.00	69.25	37.19
Kansas State Agric. College	October 8	88	44.39	39.05	56.17	28.59
U. of Minnesota	September 26	337	65.45	62.34	89.40	38.11
Montana State College	September 25	66	47.05	45.42	54.75	37.19
U. of N. Carolina	October 19	30	66.50	65.00	83.30	50.00
Rutgers Univ.	October 30	67	90.32	94.50	116.00	82.67
U. of Washington	October 2	142	69.71	73.80	94.30	39.00

ENGLISH APTITUDE, EA–1, REVISED

U. of Arkansas	September	95	42.21	42.00	48.58	35.65
Poly. Inst. of Brooklyn	September 24	90	37.22	38.03	44.33	30.00
Case School of Applied Science	September 23	180	39.89	41.37	47.13	34.11
U. of Iowa	September	1,030	38.25	38.09	44.85	31.51
Kansas State Agric. College	October 1	90	33.89	36.25	43.75	26.25
U. of Minnesota	September 28	332	41.34	41.63	47.58	35.69
Missouri School of Mines	September 25	119	44.75	44.93	50.06	39.58
U. of Nebraska	October	200	37.72	38.01	44.25	32.50
U. of N. Carolina	October 27	71	33.67	32.09	38.28	26.09
Rutgers Univ.	November 4	74	46.28	47.93	51.96	40.56
Univ. of Virginia	October 30	29	39.31	40.75	46.13	33.38
Washington & Lee	October 9	29	37.09	37.00	44.25	30.67

ENGLISH TRAINING, ET–1, REVISED

U. of Arkansas	September	94	75.99	71.64	108.25	52.00
Poly. Inst. of Brooklyn	September 24	90	80.83	81.81	105.13	57.00
Case School of Applied Science	September 24	184	93.09	92.98	116.17	71.00
U. of Colorado	October 15	189	90.00	90.80	110.96	66.71
U. of Iowa	September	1,021	87.46	86.04	109.91	61.89
Kansas State Agric. College	October 8	86	69.38	65.50	82.00	52.72
U. of Minnesota	September 28	336	94.44	92.74	119.50	71.08
Missouri School of Mines	September 29	117	79.97	80.75	103.82	54.33
U. of Nebraska	October	200	86.30	81.32	107.36	53.59
U. of N Carolina	September 15	64	65.59	59.50	84.50	39.50
Rutgers Univ.	November 2	75	108.90	109.95	126.38	90.44
Washington & Lee	October 12	28	79.75	79.10	103.83	57.17

TABLE 5. *Continued*

MATHEMATICS APTITUDE, MA–1, REVISED

Name of College	Date Given	Number	Mean	Median	Upper Quartile	Lower Quartile
U. of Arkansas	September	107	25.57	23.77	33.58	16.44
Poly. Inst. of Brooklyn	September	90	30.28	31.67	38.44	22.27
Case School of Applied Science	September 23	176	29.38	29.75	36.73	22.86
U. of Cincinnati	November 9	77	33.96	35.00	42.81	26.41
Kansas State Agric. College	October 1	91	23.47	22.67	30.67	15.24
Michigan State College	September 17	148	28.07	28.30	34.73	19.71
U. of Minnesota	September 26	333	28.63	28.89	35.81	21.03
Missouri School of Mines	September 26	127	29.73	29.66	36.51	23.05
U. of Nebraska	November 21	160	30.32	28.97	38.67	21.19
U. of N. Carolina	October 19	70	20.71	19.16	25.50	11.92
Purdue University	October 23	100	28.65	28.25	35.36	21.59
Rutgers Univ.	October 31	70	34.21	33.50	42.08	27.67
Stevens Inst.	October 22	146	38.70	39.36	45.80	31.38
Tufts College	November 11	89	27.87	37.27	39.01	26.85
U. of Virginia	October 30	29	28.62	27.08	35.42	19.56
U. of Washington	October 1	157	29.17	29.21	37.30	18.70
Washington & Lee	October 5	29	26.57	28.00	33.28	19.60
U. of Wisconsin	October 20	249	30.62	30.39	40.04	21.47

MATHEMATICS TRAINING, MT–1, REVISED

U. of Arkansas	September	107	30.08	28.61	38.25	21.38
Poly. Inst. of Brooklyn	September 30	95	39.79	41.11	47.66	29.38
Case School of Applied Science	September 25	186	40.05	40.07	47.25	33.20
U. of Cincinnati	November 9	82	45.00	46.67	48.55	37.92
U. of Colorado	October 22	185	41.11	41.57	49.82	33.06
U. of Iowa	September	302	30.60	30.41	37.07	23.15
Kansas State Agric. College	October 8	95	29.58	31.72	37.19	21.12
Michigan State College	September 17	149	33.91	33.53	41.52	26.07
U. of Minnesota	September 26	329	32.75	33.04	40.50	24.40
Missouri School of Mines	September 25	126	37.90	38.04	44.21	30.47
U. of Nebraska	November 21	182	41.18	41.37	49.20	33.20
Purdue University	October 2	100	37.55	36.62	46.62	29.06
Rutgers Univ.	October 31	71	50.21	51.47	57.25	43.25
U. of N. Carolina	October 31	76	25.20	24.08	31.25	17.05
Stevens Inst. Tech.	October 8	146	50.51	51.50	57.00	44.06
Tufts College	November 11	84	37.32	42.00	50.50	33.65
U. of Virginia	October 30	29	37.24	39.29	44.79	26.25
U. of Washington	October 1	166	36.45	36.60	45.40	27.60
Washington & Lee	October 7	29	33.64	35.25	40.33	28.75
U. of Wisconsin	October 22	250	40.40	39.85	48.75	32.76

TABLE 5. *Continued*

PHYSICS APTITUDE, PA–1

Name of College	Date Given	Number	Mean	Median	Upper Quartile	Lower Quartile
Poly. Inst. of Brooklyn	September 29	95	121.55	124.81	140.13	104.73
Carnegie Institute	September 21	193	143.01	142.34	148.89	130.97
U. of Colorado	October 29	184	123.03	126.91	140.19	108.07
Kansas State Agric. College	October 1	82	105.96	108.07	126.32	90.06
U. of Nebraska	November 28	153	128.09	138.65	142.75	114.13
Penn. State College	October	93	117.62			
Purdue Univ.	April	533	134.25	136.56	146.79	124.31
U. of Pittsburgh	September 23	47	105.35	118.86	126.09	85.00
Rutgers Univ.	November 2	62	138.53	140.06	148.67	129.83
Stevens Inst. Tech.	October 21	147	137.02	139.37	148.56	129.70
U. of Washington	October 2	126	117.99	121.50	134.30	102.80

PHYSICS TRAINING, PT–1

Poly. Inst. of Brooklyn	October 1	97	68.73	69.08	88.64	49.69
Carnegie Inst.	September 22	193	91.60	91.09	113.02	72.65
U. of Iowa	September	154	55.36	54.17	70.00	38.18
Kansas State Agric. College	October 8	79	60.43	56.85	79.78	39.19
U. of Nebraska	November 28	155	66.69	63.30	84.03	46.52
Penn. State College	October	86	54.62	50.93	72.68	36.32
U. of Pittsburgh	September 23	43	29.62	36.00	47.56	25.25
Rutgers Univ.	November 2	62	78.21	75.50	95.75	58.00
Stevens Inst. Tech.	October 7	146	86.08	88.39	103.88	67.25
U. of Washington	October 2	143	68.14	66.80	87.10	47.40
U. of Washington		77	92.81	97.80	108.80	74.50

TABLE 6

COMPARISON OF RELIABILITY COEFFICIENTS FOR FORTY MINUTES' AND FOR EIGHTY MINUTES' TESTING TIME

Name of Examination	Reliability 40 Minutes' Testing	Reliability 80 Minutes' Testing
Chemistry Aptitude	.88	.94
Chemistry Training	.93	.96
English Aptitude	.82	.90
English Training	.90	.95
Foreign Language Aptitude	.97	.98
French Training	.93	.96
Spanish Training	.82	.90
Mathematics Aptitude	.86	.92
Mathematics Training	.88	.94
Physics Training	.85	.92

TABLE 7

NORMS, IOWA PLACEMENT EXAMINATIONS, SERIES 1, REVISED, FORM A

	CA	CT	EA	ET	FA	MA	MT	PA	PT
Number of Cases	5,917	1,726	8,583	7,566	1,790	5,460	4,437	3,126	1,274
Mean	53	70	40	96	78	26	34	116	70
Median	53	68	40	95	78	26	33	119	69
Upper Quartile	69	94	47	123	97	34	43	137	92
Lower Quartile	38	44	33	66	59	18	24	96	46
Standard Deviation	21	34	10	38	27	11	13	28	31
Percentiles									
99	98	152	60	173	138	54	63	164	142
90	82	116	52	147	114	42	51	149	111
80	73	100	48	130	102	36	46	141	98
70	66	88	45	118	93	32	42	134	87
60	59	78	43	106	85	29	37	127	78
50	53	68	40	95	78	26	33	119	69
40	47	59	38	83	73	23	30	111	60
30	41	49	35	72	62	20	26	101	51
20	34	39	32	60	54	16	22	90	41
10	26	25	27	46	42	12	16	77	28
1	10	2	17	21	22	4	5	47	2

Abridged norms for French Training and Spanish Training, on a smaller number of cases, are given below.

	FT	ST
Number of Cases	677	606
Mean	60	42
Median	57	40
Upper Quartile	75	51
Lower Quartile	41	31
Standard Deviation	25	16

Norms. Composite scores for comparative purposes.

Mean. Arithmetic mean, or average.

Median. The middle score, or score exceeded by one half of the cases.

Upper Quartile. The score *above* which are one quarter of the group tested.

Lower Quartile. The score *below* which are one quarter of the group tested.

Percentile. The *p* percentile is the score *below* which are *p* per cent of the cases. The fiftieth percentile is the median.

Standard Deviation. The square root of the mean of the squares of deviations from the arithmetic mean of the scores.

ANNOTATED BIBLIOGRAPHY

(1) Cornog, J., and Stoddard, G. D. "Predicting Performance in Chemistry." *Journal of Chemical Education*, Vol II, No. 8 (August, 1925), pages 701–708.

This article describes the Placement Examinations in Chemistry from the following standpoints: Necessity for the examinations; the nature of the examinations; the philosophy and content of the aptitude and training examinations; data and conclusions; and a theoretical discussion of the values and uses of these tests.

(2) Cornog, J., and Stoddard, G. D. "Predicting Performance in Chemistry, II." *Journal of Chemical Education*, Vol. III, No. 12 (December, 1926), pages 1408–1415.

This article gives tentative answers to the following questions: How accurately are students placed by the Iowa Placement Examinations in Chemistry Aptitude and Chemistry Training? Are there notable differences in the quality of institutional groups of students taking freshman Chemistry? How much and what kind of Chemistry is retained by Freshmen who have had high school Chemistry?

(3) Langlie, T. A. "Analysis of the Iowa Placement Tests." *Journal of Applied Psychology*, Vol. X, No. 3 (September, 1926), pages 303–314.

This study consists of a critical analysis of the behavior of the Placement Examinations in English, Mathematics, and Chemistry. The data were obtained at the University of Minnesota. All tests were in the *tentative* series of Placement Examinations. Below are given Langlie's conclusions. That these findings are subject to interpretations differing from those of Langlie has been pointed out by Stoddard (18).

(*a*) "The tests under consideration do differentiate fairly well, except the Chemistry Aptitude test with its coefficient of variability .09." (This coefficient was raised to .22 in the revised series of 1925.)

(*b*) "Each test is dependent to a fair degree upon general intelligence, particularly the aptitude tests."

(*c*) "A particular aptitude is dependent upon training in that particular line."

(*d*) "Mathematics Training and Chemistry Training as measured by these tests have considerable in common, presumably training in mathematics."

(*e*) "The training tests in Mathematics and Chemistry are different from intelligence and aptitude tests."

(*f*) "Finally, we may conclude that the factors measured by these tests are: general intelligence, training in particular subjects, and mathematical aptitude."

(4) LANGLIE, T. A. "The Administration of Placement Examinations." *School and Society*, Vol. XXIV, No. 620 (November 13, 1926), pages 619–620.

This article compares the examinations in English, Mathematics and Chemistry used at the University of Minnesota in 1924 and 1925, and indicates superiority of the 1925 edition in measuring individual differences among college freshmen. Correlations are given which indicate that the superior examinations of 1925 did not in the case of Mathematics Training and Chemistry Training produce higher relationships between test performance and semester grades. Langlie attributes this to the fact that the examinations were given earlier in the semester of 1925. He proposes that these examinations should be given two or three weeks after the opening of the semester in order to permit a brief review of the subject matter on the part of the students.

(5) LANGLIE, T. A. "The Iowa Placement Examinations at the University of Minnesota." *Journal of Engineering Education*, Vol. XVII, No. 9 (May, 1927), pages 842–860.

This report utilizes data obtained at the University of Minnesota in 1924, 1925 and 1926 for the Training and Aptitude Examinations in English, Chemistry and Mathematics. Below are the questions emphasized in the study together with the conclusions reached.

(1) "Do the Placement tests adequately reveal individual differences among college Freshmen?"—"The Placement tests reveal individual differences to an unusually high degree, coefficient of variability being above .30 for all but two tests, E.A., .18, and C.A., .22. The 1925 edition is greatly improved over the 1924 edition in this respect."

(2) "Do the Placement tests throw light on the adequacy of the present classification of students in the departments of Mathematics and Chemistry?"—"As a check on the classification of students in the mathematics and chemistry departments, the training tests are more effective than are the aptitude tests. The different courses in these departments are composed of fairly homogeneous groups of students, each group being different from the other as far as these special abilities are concerned."

(3) "Could the tests be used for sectioning classes on the basis of ability in English, Mathematics, and Chemistry? If so, should the tests be given before registration or after brief review in each subject?"—"Sectioning classes on the basis of ability could be done fairly successfully with scores on the aptitude and training tests as guides. English classes in particular could be sectioned on the basis of ability with a minimum of error. More than 33 per cent of the grades of English classes (1925) were predicted exactly, this with scores on the English training test alone ($r = .63$). Sectioning in the mathematics and chemistry departments probably could have been done with almost equal accuracy if the training tests had been administered at a later date, when the students would have had an opportunity for a short review."

(4) "Do the tests yield valuable information for the use of the Dean's office, Student Work Committees, and Advisers?"—"The placement tests yield valuable information for administrative purposes such as personnel work, students' work committees, and advisory work. Encouragement and discouragement of continued study at the University can be done much more accurately when test scores are used as a guide than when scholarship and impressions alone are considered."

(6) LEMON, A. C. "An Experimental Study of Guidance and Placement of Freshmen in the Lowest Decile of the Iowa Qualifying Examination, 1925." *University of Iowa Studies in Education*, Vol. III, No. 8 (February 1, 1927); 135 pages.

This study reports the carrying out of a rigorous experiment on the effectiveness of individual student analysis and remedial instruction. An experimental and a control group were carefully matched on the basis of intelligence and Placement Examinations, and various environmental conditions. For a period of one

semester members of the experimental group were diagnosed psychologically and educationally and shown how to improve in reading ability, methods of study, interest-taking, etc.

A striking improvement was obtained for the experimental group in average scholarship and in the number surviving the first and second semesters. Thus in the control group only 17 (out of 53) were eligible for registration at the beginning of the Sophomore year, while in the experimental group 32 (out of 53) were eligible. The study includes an analysis of the remedial technics found to be effective and sets up a plan of adjustment which, it is believed, would reduce significantly the high percentage of elimination among beginning college students.

(7) REMMERS, H. H. "A Diagnostic and Remedial Study of Potentially and Actually Failing Students at Purdue University." *Purdue University Studies in Higher Education IX*, May, 1928; 164 pages.

"This study deals with approximately the lower twenty-five per cent of the freshmen at Purdue University as measured by various tests. The problem attacked is that of the possibility of improving scholastic achievement by means of directed study. The methods used are as follows: (1) a diagnostic investigation in terms of tests, interviews, and the collation of various kinds of sociological, familial, and educational data; (2) a division of the students into two comparable groups with special treatment of one of these by means of directed study especially in English and mathematics, the other group serving as a control group; (3) the second semester those freshmen not in the lower quartile on entrance tests who failed to carry twelve semester hours of passing work (*i.e.*, probationers) were also given special treatment. The remedial aspects of the study produced results which indicate that the procedure employed held seventy per cent of the experimental group as against fifty-two per cent of the control group in the University throughout the year. The mean differences are in all cases slight, but usually in favor of the experimental group. The study indicates the need for better educational and vocational counseling in the secondary schools than now obtains. No unequivocal results were obtained in the case of the probationers."

(8) RUCH, G. M., AND STODDARD, G. D. *Tests and Measurements in High School Instruction.* World Book Company, Yonkers-on-Hudson, New York, 1927. 382 pages.

"In part one the following major uses of standardized measures are classified and discussed: (1) Supervision and administration of instruction; (2) diagnosis of special difficulties; (3) grading, promotions, and sectioning of classes; (4) research purposes; (5) motivation of learning. In part two appears a

full description of available high school tests, classified by subjects. A statement is made concerning what each test measures, how to administer and score, how to interpret and utilize the results, the establishment of norms, and the validity and reliability of the tests. Part three covers informal objective examination methods as they may be successfully applied to high school instruction. Part four presents the fundamental principles underlying the construction of educational and mental tests. The sequence of steps in the production of typical tests is developed in some detail. The important steps in the construction of tests and scales are covered: validation, breaking the test items into equivalent forms, derivation of norms, determination of reliability, and perfecting the administration of the test."

(9) SEASHORE, C. E. "Sectioning on the Basis of Ability." *Bulletin of American Association of University Professors*, Vol. IX, No. 6 (October, 1923), pages 9–24.

This report establishes a strong logical case for the sectioning of classes both in principle and practice. Various objections to the plan are met by the writer and some preliminary comments from teachers are appended.

(10) SEASHORE, C. E. "Comments on the Plan for Sectioning Classes on the Basis of Ability." *School and Society*, Vol. XVI, No. 140 (November 4, 1922), page 514 ff.

This article consists of a series of comments from nineteen colleges and universities on the plan of sectioning previously proposed by the writer. Institutions which have put the plan into practice reported favorably on it.

(11) SEASHORE, C. E. "College Placement Examinations." *School and Society*, Vol. XX, No. 515 (November 8, 1924), pages 575–577.

This constitutes the first published article describing briefly the nature and purpose of the trial edition of the Iowa Placement Examinations. The essential guiding principles are set forth.

(12) SEASHORE, C. E. "The Placement Examinations as a Means for the Early Discovery and Motivation of the Future Scholar." *National Research Council Bulletin*, reprinting an address of October 29, 1925.

The author sets up "fourteen points" believed essential in making the proper educational recognition of individual differences among students. The Placement Examination procedure is considered of prime importance among these projects.

(13) SEASHORE, C. E. "Learning and Living in College." *University of Iowa Studies*, Vol. II, No. 1 (March 1, 1927); 124 pages.

The writer sets up the educational goal, "to keep each individual busy at his highest natural level of successful achieve-

ment," and organizes the discussion about certain major procedures designed to promote this end. Among these are selection of students, Placement Examinations, Freshman Week, individualization of recitation and laboratory, sectioning of classes, the project method, the Junior College, and honors and awards. For the most part the elaboration of the principles underlying these projects is accompanied by an account of the way they have worked out under actual conditions at various institutions.

(14) STODDARD, G. D. "Iowa Placement Examinations." JOURNAL OF ENGINEERING EDUCATION, Vol. XVI, No. 1 (September, 1925).

A brief summary of the results obtained with the tentative edition.

(15) STODDARD, G. D. "Iowa Placement Examinations, Fall of 1925, Preliminary Report." JOURNAL OF ENGINEERING EDUCATION, Vol. XVI, No. 7 (March, 1926), pages 475–483.

This report consists of a series of tables giving for each particular college and for each Iowa Placement Examination the number of students taking the test, and the mean, median, upper quartile, and lower quartile obtained.

(16) STODDARD, G. D. "Iowa Placement Examinations." *University of Iowa Studies in Education*, Vol. III, No. 2 (August 15, 1925); 103 pages.

This study comprises the first complete account of the Iowa Placement Examinations (tentative edition). It describes the experimental work undertaken by a group of men at the University of Iowa in cooperation with the Society for the Promotion of Engineering Education. Ten thousand cases are reported. The chief topic headings are: The need for the investigation; a survey of similar investigations; the function of Iowa Placement Examinations; a description of the content of the examinations; a statistical study of the examinations; the method of revising the examinations; various types of norms; and the effectiveness of the examinations in predicting scholastic success in a particular college subject. Through the technique of partial and multiple correlation the superiority of Placement Examinations over intelligence tests in predicting performance is indicated. The utility of the distinction between aptitude and training is brought out.

(17) STODDARD, G. D. "Iowa Placement Examinations." *School and Society*, Vol. XXIV, No. 607 (August 14, 1926), pages 212–216.

A general account of the nature and purpose of the examinations. The usefulness of the examinations in various types of student personnel work is pointed out.

(18) STODDARD, G. D. "Iowa Placement Examinations—A New Departure in Mental Measurement." *Psychological Monograph, University of Iowa Studies in Psychology*, Vol. XII.

A critical analysis of theoretical points involved in measurements by Placement Examinations.

(19) THARP, JAMES B. "Sectioning Classes in Romance Languages." *Modern Language Journal*, Vol. XII, No. 2 (November, 1927), pages 95–114.

This study describes the carrying through of a definite experiment in French instruction at the University of Illinois. Iowa Placement Examinations proved effective in placing students in their proper level of ability, as shown by the marks received at the end of the semester. The conclusions definitely favor the plan of class sectioning.

(20) YOUNG, C. E., AND VAN DER BEKE, G. E. "An Experiment in First Year French." *Modern Language Journal*, Vol. XI, No. 1 (October, 1926), pages 25–31.

"This experiment was conducted on the assumption that students will make more rapid progress in reading ability in the long run if at the beginning of the course they are tested for their knowledge of certain important items, and if steps are taken to remedy the defects of the individual student." The Placement Examination, French Training, was employed and a series of remedial drills given to overcome weaknesses in student preparation. At the end of the semester the experimental group had outdistanced six other groups which were taught without preliminary testing.

More recently further experiments at the University of Iowa not reported in this article have corroborated these preliminary findings as to the value of early knowledge of the aptitude and training of beginning college students.

ADDRESS OF WELCOME

The Significance of the Engineering Attitude in Modern Life

HARRY WOODBURN CHASE,

President, University of North Carolina

Mr. President, Ladies and Gentlemen, I rise tonight in an exceedingly apologetic state of mind. I think that perhaps I am becoming the champion pinch-hitter of this vicinity. Only about two weeks ago, through a sudden combination of circumstances, I was called on to do that extraordinarily tragic thing which a college president has to do—to make his own commencement address and send the graduates out in the world with advice from no one more worldly than himself.

I went to the mountains a while to recuperate from that sad experience, and while there, Dean Braune informed me that the man who was to speak tonight (who is a real orator) could not be here and that once again I would have to do the pinch-hitting. I was under difficult circumstances because I wanted to find something sufficiently abstruse to talk about to command your respect, and at the same time I was neither scientist nor engineer. I used to be, once upon a time, a student of psychology, but you well know a college president, once he falls from grace, soon loses all intellectual capacities, and uses psychology in a very practical, shall I say, sense.

And therefore, in what I shall have to say tonight, I remind myself very much of the Negro who was trying to get a divorce from his wife. When he went before the Judge, the Judge asked on what grounds he was asking for his divorce.

The Negro replied, "Ah, dis wife ob mine, she jus' talks and talks and talks. I cain't hear her talking no mo'. She talks all de time."

The Judge asked, "What does she talk about?"

And the Negro answered, "Ah, boss, that's jest de trouble —she doan' say!"

So I suspect that in these very fragmentary, disjointed and incoherent remarks of mine tonight, you are going to detect just about the same attitude and state of mind.

I am venturing a few remarks on what I might call, I suppose, the significance of the engineering attitude in modern life. Of course, it is a commonplace and a platitude that the modern world has been made over by the achievements of science. That platitude is so attractive that I think we fail sometimes to recognize the fact that like a good many other platitudes, it only states half of the truth because it seems to me that science as such, if I may use that favorite academic expression, is after all, only concerned with one thing, and that is with the advancement of human knowledge, independently of whether any human problem is solved by that advance or any benefit is conferred up the human race.

I might say one thinks of the physicist in his laboratory as he is investigating the structure of matter; one thinks about the chemist or about the mathematician as he is deriving his formulas, as not moved by any sort of immediate and practical considerations, as not interested in civilization, as not interested in the advance of humanity, but interested in expanding frontiers of human knowledge, and when he has done that, he has fulfilled his obligation to science and his obligation to truth. And before any modification can take place and any advantage can be made of the situation, something else, it seems to me, must come into the picture, and that "something else" I should like to call tonight the "engineering attitude."

If I should venture to describe what I mean by that attitude, I should, I think, say three things about it. In the first place, it grows out of a practical problem which has to be solved, a definite and concrete situation which has in some way to be modified. The problem, for example, is the question of how you can house a great many people on land which has a tremendous value per square foot, and out of a solution of that

problem comes a whole new type of architecture in the modern world. Or your practical problem is, how can you transport vehicles at high rates of speed over long distances, and out of a solution of that problem comes an entirely new system of highway transportation in modern life.

And so, it seems to me, the first thing that is clear is that wherever you find this engineering attitude in modern life, you find it growing out of a definite and concrete problem of human value which somehow has to be met and solved.

The second thing that is characteristic of this attitude is the fact that in the analysis and in the solution of this problem, one applies to it a body of knowledge which the scientist has furnished. Science comes in, let us say, as the second step in the solution of the problem. One takes the formulas of the mathematician, the knowledge of the physicist, the researches of the chemist, and he puts them to work, but he puts them to work in the service of a definite and a practical situation.

There is a third thing about the engineering attitude which, I believe, is this: That the engineering solution must not only be true in the theoretical way, but it must be practicable, it must work out in terms of the common, everyday life of humanity. Factors like cost, like manufacturing problems, even factors of public opinion, legal questions, a host of practical details must be solved by the engineer, and must be considered by the engineer in his work, which are not the concern of the scientist himself.

I suspect all that sounds very simple and commonplace to a group of engineers—to say that the engineering attitude consists first of all of a practical situation which must be met, that it consists second of the application to that situation of a body of scientific knowledge and fact, and that it consists third of the formulation of a practicable and workable solution—but the interesting thing to me is, that simple and obvious as it seems within the more technical fields of engineering, we are just beginning to realize the immense significance and importance of that attitude in other human fields. One takes for instance, to illustrate what I mean, the difference between the Seventeenth Century attitude toward disease and

the modern or shall I say the engineering attitude toward disease?

Some of you have read that terrible picture which Defoe gives of the plague in London, and you recall the fear and the horror of that visitation, the corpses piled in the streets, the fires burning, people fleeing by the thousands from London for safer places, and the attitude of hysteria, almost insanity which pervaded that entire population. Compare that, if you like, with the twentieth century method for the control of epidemics; the sanitary measures which we have learned how to take in modern civilization, our preventives, our control of sources of infection, and what has happened? It seems to me that what has happened is just that we have learned to apply to the area of human experience exactly the principles which I have described as the engineering attitude.

Again, one takes the question of agriculture. Your practical problem is, let us say, how to increase the production of your crops. The ancient world had a theory about that and you find that all primitive culture is shot through with measures to increase the yield of corn crop or the wheat crop by dances, by incantations, by means that somehow through sacrifice were supposed to increase the fertility of the fields in a ritual of emotion, magic, and of a passionate desire somehow to coerce the spirits of the process. Compare the ancient divinities of woods, field and stream that were supposed to make the growth of crops a possible situation—compare that with the calm, dispassionate way in which the intelligent farmer of today goes to work about the process of building up the fertility of his land, his seed selection. He is not solving his problem in terms of emotion and magic, but in terms of his increasing reliance of an increasing body of scientific data which have brought about the production of modern agriculture.

Or, take a field even farther removed from the technicalities of engineering itself. One sees exactly the same process at work in the economic life of the world today. You remember from your college days, the old system of economics in which we were presented with the idea there was somehow,

a creature called an economic man, and that that man somehow regulated his life by such principles of logic that he always bought in the cheapest market and always sold when prices were most dear. Anybody who has played the stock market knows differently! I wish you would compare that, if you will, with the whole great body of knowledge about human impulses in buying and how to appeal to them that is at the basis of the millions and millions of dollars that the American people and American business firms spend annually on advertising. The advertiser knows perfectly well that there is a psychology about buying and a psychology about selling, and the fiction of the magical economic man who used to be considered as existing is simply a fiction, and he is learning more and more to apply scientific data to the question of selling goods. In other words, he is developing the engineering attitude toward his business just as the manufacturer more and more is developing the engineering attitude in the standardizing and the production of his product.

These may serve as illustrations of what I mean when I say more and more the engineering attitude, the attitude on which the engineering profession is based, is coming to permeate our thinking in the modern world. One thinks about this whole process of education, and you in this Association have been among the first to recognize the fact that education is after all, a great achievement in human engineering. I mean to say that you people in your studies of engineering education have gone farther than most of us in trying to work out a body of scientific data which could be applied to the educational process itself. All through these years and all through these centuries, education has been largely the question of prejudices that people held, of the particular theories that dominated their minds, and it is only within very recent years that we are coming to realize that after all, there is a body of fact and a body of knowledge which can be applied in the engineering spirit to the educational process itself.

One hears a great deal of discussion about all sorts of fundamental things in education. "There are too many people going to college," says someone.

"No," says somebody else, "There aren't enough people going to college" and in terms of our particular theories of society and particular attitudes toward people, we wage endless discussions about that fundamental question. I think perhaps some day we can settle that question, but I don't think we will ever settle it by arguing about it back and forth. We will only settle it as we learn to apply to it questions of an engineering type—facts and not emotion, and the data of science, not prejudice.

We argue at length about curricula, liberal curricula, professional curricula, and much of our argument after all, comes out the same doorway it went in, simply because we haven't yet fully learned that lesson that here is a region of human achievement in which a fundamental attitude must be built up if we are going to get anywhere with what we are trying to do. The question of intelligence, and questions of relative achievement, questions of the relationship, as Colonel Rees has been saying this afternoon, between college success and achievement in life afterward, are all before us. After all, if we only steadily and insistently apply facts and the method and the spirit of engineering science, we would get, in twenty-five years of investigation farther than we would in a century and a half of argument. That is just the central point that I want to make tonight. It is the fact that we are just emerging from a period in which we have made a fundamental division in our thinking about life.

We have set over here on the one side, a territory in which we have agreed that there are things which can be discussed, worked out and experimented with in terms of the facts of science and in terms of the fundamental engineering attitude, which will bring us through to a correct solution. We have set over on the other side, these great factors of human life in society, in education, in politics, in national and international affairs, in which we seem to have taken the attitude that the only working method is the method which the human race has followed for thousands and thousands of years, methods of argument, methods of emotion, and methods of prejudice.

Only within this last generation are we beginning to see that that division is a false division, that the attitude you men have had about engineering and about the problems that come within our scope is an attitude that can be applied if only we will try hard enough to apply it to any sort of human problem, and that the success of modern civilization is going to depend more and more on the persistency and directness and honesty with which we learn to apply engineering methods to areas of human experience that so far have lain outside their scope.

That has come to be with me a very real point of view, the point of view that in this factual approach we have got something which after all, furnishes the great unifying power more and more in modern life. We have gone far beyond the point where all of us who are educated people can have the same body of knowledge. Not any more do we all know the same Latin, the same Greek, the same humanities or even the same science, and men who specialize talk to each other almost in different languages at times. That, perhaps is one of the penalities which we must pay for the development of modern knowledge, but isn't it true that there is a real fellowship among all educated men, and a growing and increasing fellowship in so far as we realize that these fundamental attitudes like that which I have called this engineering attitude, bring together all this great complex structure of life today and make us all realize with a deep sense of fellowship, that we are working in the same field and working for the same cause?

And so, I, who stand outside of this engineering profession, and outside the region of science, feel that men who are concerned with education in a modern sense and who are concerned with humanity and with its problems, are deeply at one with the purpose and attitudes of you men, and that as we learn, in a deeper and perhaps a more modern sense of fellowship, to go forward, shoulder-to-shoulder in the attack on modern civilization in this confused and confusing age, that we will come to realize more and more that the only possible attack is the attack which has been waged so successfully by you men in the field of your choice and your achievement.

RESPONSE TO ADDRESS OF WELCOME

BY R. L. SACKETT,

President of the Society

Mr. President, in the name of the Society I accept this gavel, together with the very cordial welcome which you have extended to us. The greetings have already manifested themselves in the actions of the various committees appointed here to make arrangements for the entertainment of this body, and we already feel ourselves quite at home in these cordial surroundings.

This gavel, coming as it does from one of the oldest state institution buildings in the country, and being of walnut, it typifies in a peculiar way, the beauty of education, and the durability of it in material, being one of those which lasts through long periods of time in the ground or in the air symbolizes the enduring qualities of true culture. The polish which it takes on is typical (and I hope it is not superficial) of that which does or should come through the channels of education.

It is particularly pleasing to us that we should have met here on this occasion to lend whatever support we may be able to lend to the efforts of this institution under your guidance, to assist in that development of wealth in the state of North Carolina, about which perhaps we are not fully informed.

We came here perhaps with two ideas in our minds: first, that we would see evidence of that hospitality for which you are famous, the reputation of which has gone far from your homes; secondly, to see something of the material wealth which had been developed here, with no idea of taking it away with us nor making large contributions to it while we are here, but rather with the idea of seeing how you do it.

We realize that in the course of three years you have spent $76,000,000 in the improvement of roads, meaning an improvement of some six thousand miles, at a cost of approximately

$12,000 per mile. That is some accomplishment. It was somewhat surprising to find that this state contributed more largely to Federal taxes that any other state in the Union, excepting New York and Pennsylvania. It was somewhat surprising to find that in the course of twenty years, the wealth of this state had increased ten times, and to find that within twenty years, the bank deposits and savings and building and loans accounts had increased twenty times.

The development of the Southern Power Company, now called the Duke Electric Corporation, has been also in some considerable measure, romantic, there having been invested in that series of hydro-electric developments some $200,000,000, which to a considerable extent is an addition to the wealth that existed in this state before those enterprises were undertaken. All told, that is a considerable accomplishment in the field of material development, and yet we are not especially or primarily interested in the development of the material wealth, though it is necessary to develop education that there should be funds available. But, we are more particularly inspired by the contributions to education which have been made in this state in the last few years, when we realize that in 1900, the total contributions of this state toward secondary and high school education amounted to one million dollars or a little over, and that last year they amounted to over thirty-four million, more exactly thirty times as much. When we realize that the total investment in, or assessed valuation of, school properties of the secondary and high school range was a matter again of only a little more than one million dollars in 1900 and seventy millions last year, we get a clearer picture of your great progress. An increase in the assessed valuation of the property devoted to this purpose of over seventy times in twenty-five years is a real accomplishment.

The actual increase in population in this state has not been large through migration. The actual attendance at schools of the secondary and high school type has doubled from four hundred to eight hundred thousand during this twenty-five-year

period. The number of teachers in the schools has more than trebled in this time. At the beginning of the period, there were some five hundred schools in vocational work. Today there are sixteen thousand.

Those are factors which help to picture to us what you have been doing here in such a quiet and in such an inspiring fashion. If this Society can lend anything to your support and to encourage those who stand here at the top of the educational pyramid of the state to continue, that is our sincere desire, because this Society, while it is interested in engineering education particularly, and feels that it is a part of the great structure of education, recognizes that ultimately, that which we may call spiritual growth, depends upon education and its development within a commonwealth.

We therefore wish for you a continuation of this material prosperity, but more particularly, that you may strive as leaders in the field of education.

REPORT OF THE SECRETARY, 1927–1928

F. L. BISHOP

"This Society was organized at the close of the Engineering Congress held in Chicago in August, 1893. It grew out of a common feeling of the seventy or more members of Section "E" of that Congress on Engineering Education that a permanent organization should be established of those engineers and teachers most interested, which should meet annually for conference and discussion." (Thirty-five years later we are meeting for "conference and discussion," but instead of seventy members we now have thirty times that number.)

"The shaping of the technical education of a nation is a work which may well call for the continuous service of our ablest educators, and the advantages of participating in the work should accrue to each and every school, college, or university in this country, which undertakes to impart technical instruction, through its professors and teachers who are members of the Society which is principally charged with this work. There is now little question that this Society will have a great and lasting influence in shaping the development of our engineering schools, and while the teachers of our leading technical schools have, to date, shown the greatest interest in this work, the greatest advantages are likely to be reaped by those members who represent the newer and smaller schools, the principal development of which is still in the future."

"In the last quarter of a century, it is doubtful if progress in any direction has been more marked, more rapid, or more substantial, than progress in Engineering Education. If still more nearly perfect and substantial results are to be secured in the future, there is need that attention should be given to educational methods, and to better organized and more systematic effort, and to this end the S. P. E. E. is in

position to perform an important function. It hopes to receive the moral support of institutions as well as of the individuals who represent them."

"No form of education has taken a stronger hold upon the public or has developed so rapidly and successfully in the last third of a century as has engineering education. It inculcates earnestness, thoroughness and accuracy in the student in a pre-eminent degree. The spirit which pervades engineering colleges can properly be expected to secure superior results, not merely by virtue of the subjects taught, but also by improving the quality of teaching, perfecting methods of presentation, and adapting means to ends in instruction as has been done in engineering. It is the purpose of the Society to aid in bringing about this result. The work of teaching engineering subjects is sufficiently new, so that much saving will result in teaching, as in engineering, if the experience on the part of one shall prevent needless experimenting on the part of many."

The above statements are taken from the early volumes of the *Proceedings* of this Society. How truly the founders of the Society spoke! What visions of achievement they had. The Board of Investigation and Coordination has followed the path marked by the founders of the Society, but has not reached the end yet. The new investigation of non-collegiate technical institutes is just another milestone and who knows what marker might be on the next one.

The Headquarters of the Society.—The headquarters of the Society have been at the University of Pittsburgh since 1914 when the undersigned was elected secretary. I wish to take this opportunity of expressing to the Chancellor and to the Board of Trustees of the University my appreciation for the cooperation and assistance which they have given to the secretary's office during this period of fourteen years.

The financial statement presented by the Treasurer, Mr. W. O. Wiley, will show that the finances of the Society are in good condition, the work of the year being finished without a deficit. However, it will be necessary for the Society to

practice economy in order that our income may meet our expenses.

The secretary's office handles all the executive work of the Society and it is here that the responsibility lies to keep the expenses of the Society below the income. With the Society expanding as it has in the past fourteen years the work of the secretary's office has greatly increased and become more complex. The editing of the JOURNAL OF ENGINEERING EDUCATION is in itself a task which would ordinarily involve from two to five persons. This is only one phase of the work of this office. We are responsible also for the publication of the year book, the collection of all dues and moneys owed to the Society, contact with committees, attending meetings, arranging programs for the annual meetings, etc. The personnel of the secretary's office consists of the Secretary of the Society and one assistant secretary.

The Journal of Engineering Education.—The JOURNAL is the official bulletin of the Society and contains all papers, reports, and discussions at the annual meeting, together with papers and articles on subjects pertinent to those interested in the promotion of engineering education. The results of the investigation of engineering education are printed in the JOURNAL and also in bulletin form. A very important part of the JOURNAL each month is that space devoted to College Notes. In these columns the members become acquainted with the changes in personnel in the different institutions, with the new equipment or new buildings, changes in curriculum, etc. As much space as is required will always be given to college notes and if your college has not been listed this past year, it is up to you to see that beginning with the next issue—September—everything of importance will be sent in for publication under this heading. Each member of the Society, individual and institutional, who is not in arrears two years receives a copy of the JOURNAL. In addition to the members, the leading libraries of the country subscribe to it. The JOURNAL contains the very last word in engineering education.

Membership of the Society.—The Membership Committee,

under the chairmanship of Professor Wm. S. Franklin, has done excellent work and has pointed the way for future committees. There are one hundred ninety-five new members on the rolls this year, forty-five of whom are a direct result of the summer session on mechanics held last summer at Cornell and Wisconsin. We now have 2050 individual members and 120 institutional members, making a total of 2170 members.

One striking fact evident in the resignations is that as soon as a teacher leaves the teaching profession to enter industrial work he nearly always gives as his reason for resigning that he is going into industrial work and is consequently no longer interested in teaching. This brings before the Society and before engineering education one of its most important problems, i.e., how can we secure in a permanent manner the interest and cooperation of professional engineers and of industry in engineering education. We are preparing and turning over to industry their most important raw material. It seems to me axiomatic that they should be vitally interested in how and what the young men in the engineering colleges are taught. The other side of the question is well stated by a prominent official of a large engineering society—"Show me a member other than a teacher who is really interested in engineering education."

Institutional Division.—It has been recognized by the officers and the Council of the Society for many years that some organization dealing particularly with administrative problems should constitute one division of the Society. This matter was first brought to the attention of the Society in an official way in 1913 in the report of the Committee on Administration. This committee was composed of F. L. Bishop, Chairman, Chas. S. Howe, and A. S. Langsdorf. The report was published in the June, 1913, number of the Bulletin of the Society. In part it read: "We recommend a new type of membership in the Society to which institutions shall be admitted . . . that each institution be asked to name a delegate to the annual meetings of the Society." It is interesting to note that at the Minneapolis meeting in June 1913 Mr. H. H. Norris, then secretary of the Society, made a similar rec-

ommendation. This recommendation was adopted by the Council and institutional membership created. There are now one hundred and twenty institutional members in the Society. Later under the direction of Dean M. E. Cooley, the Division of Deans and Administrative Officers, was created without reference to the institutional members. Last year the Council voted to combine these two under the title of "Institutional Division of the Society," with one of the Vice-Presidents as chairman of this division. It seems doubtful if this Division can perform the functions which it obviously should as long as its chairman is changed every year. I most earnestly recommend that the Council and the Society take action looking to the appointment of a chairman of this division who shall hold office for at least three years. Dean C. E. Magnusson is chairman of this Division for the current year and has worked in close cooperation with President Sackett of the Society and the Division is now in a position to function as it should.

Committees.—Much of the creative work of the Society is done through technical committees. The work of these committees is often, from the very nature of the task, long and arduous. However, their results justify the time spent on the work as they provide a continuous source of facts and methods for the improving of teaching. It is probable that the same amount of work done for another society would receive greater individual publicity. This fact alone makes the work of the committeeman more appreciated by the Society because he is giving his time and efforts for the improvement of engineering education only, and not for personal gain. As an instance of this I might cite the work of the Committee on the Standardization of Technical Nomenclature, under the direction of President John T. Faig. This committee has been at work continuously since 1914 and every year adds to its accomplishments. The exhaustive character of the work conducted by this committee is shown by its reports, one of which is being presented at this meeting. The work of the Committee on English, under the direction of Professor J. Raleigh Nelson, is familiar to all of you. Other commit-

tees have done equally good work and their results are cited not only in engineering but in other fields of education.

It is not anticipated that all of the thirty committees of the Society will have reports every year. There are six reports to be presented this year. Each report is of distinct value in its particular field. The work which the committees of the Society accomplish is especially noteworthy in view of the fact that the work must be done almost wholly by correspondence as the Society has no adequate funds to pay the expenses of members attending committee meetings.

It might be advisable for the Council to authorize the payment of the whole or part of the expenses of one committee each year for committee meetings.

Meetings of the Society.—The development of the sectional meetings of the Society has been one of the outstanding achievements in recent years. These meetings provide an opportunity for the coming together of those who are particularly interested in educational problems of a certain area and for many to attend who are unable to be present at the annual meetings. However, one of the most interesting facts is that the sectional meetings seem to have the effect of increasing the attendance at the annual meetings. They also have a decided effect on the increase of membership in the Society. Two new sections were organized this year—the Kentucky Section and the South Dakota. The sections reporting to the Secretary this year, together with their officers are:

Colorado Branch: C. A. Hutchinson, Chairman,
W. S. Nyland, Secretary.

Kansas-Nebraska Section: O. E. Edison, Chairman,
R. S. Tait, Secretary,
E. R. Dawley, Chairman, Program Committee.

Kentucky Section: W. B. Wendt, Chairman,
W. E. Freeman, Vice-Chairman,
M. B. Robinson, Secretary and Treasurer.

Minnesota Section: F. W. Springer, President,
W. H. Richards, Secretary,
G. B. Heisig, Chairman, Program Committee.

New York-New Jersey Section: A. M. Greene, Chairman,
E. H. Rockwell, Secretary.
North Carolina State College Branch: J. M. Foster, Chairman,
L. E. Wooten, Secretary,
T. P. Harrison, Journal Correspondent,
C. L. Mann, Chairman, Program Committee.
Ohio Section: F. H. Vose, Chairman,
J. E. Boyd, Vice-Chairman,
J. B. Brandeberry, Vice-Chairman,
S. A. Harbarger, Secretary.
Purdue Branch: O. L. Greiner, President.
Pennsylvania State College Branch: C. W. Beese, Chairman,
A. P. Powell, Secretary.
South Dakota Section: H. M. Crothers, President,
J. P. Kammerman, Vice-President,
L. E. Akeley, Secretary-Treasurer.

The total attendance at sectional meetings during the past year was approximately 500. The annual meeting at the University of Maine one year ago was the largest in the history of the Society, a total of 440 members and guests being registered.

Summer Schools for Engineering Teachers.—The session conducted by the Society at Cornell and at Wisconsin last summer for teachers of mechanics was one of the most important forward movements of the Society in recent years. Most of the work of the Society is beneficial to the group as a whole or to institutions, but in these sessions the individual benefits. As a result of this individual gain, his institution also gains. The value of these sessions is proved by the interest in the two conferences on mechanics to be held in connection with this thirty-sixth annual meeting. The interest was so keen that it was necessary to limit the time for these conferences in order that the regular program of the Society might be carried out. Too much credit cannot be given to Mr. H. P. Hammond for originating this idea, to the Council for approving it, and to the staff for carrying it out so successfully.

Two sessions will be held this summer—one on physics at the Massachusetts Institute of Technology, and one on electrical engineering at the University of Pittsburgh and the Westinghouse Electric and Manufacturing Company. There are more applications for the session on electrical engineering than can be accepted although the number has been increased from forty to sixty-five.

The Board of Investigation and Coordination.—Interest in the Society has been greatly augmented by the work of the Board of Investigation and Coordination under the able direction of its chairman, Charles F. Scott, its director, W. E. Wickenden, and its associate director, H. P. Hammond.

The report of the Development Committee which provided for the Board had planned a five-year program in a study of engineering education. The Carnegie Corporation, through a gift of $108,000 to the Society, provided for three years of this work. Later they added a gift of $10,000 to be used for publication expenses. When it became exident that the first gift would be exhausted before the work of the Board was completed, energetic efforts were made, especially by the Chairman, Professor Charles F. Scott, to raise additional funds for continuing the work for two years. In this manner a fund of approximately $43,100 was raised which was adequate for carrying on the work of the Board for the other two years of the five-year period as originally planned.

One of the outstanding results of this investigation was the fact that a number of young men enter engineering colleges when it would have been better if they had gone to non-collegiate technical institutes. This matter was presented by W. E. Wickenden to Mr. Pratt, of the Pratt Institute, and by him to the Carnegie Corporation. Members of the Pratt family, the Ohio Mechanics Institute, and the Carnegie Corporation have given a sum of $30,000 to the Society for the study of non-collegiate technical institutes. This investigation is now under way and will be discussed at length at this meeting by Mr. W. E. Wickenden who is to direct the investigation.

At the Maine meeting of the Society, the subject of an Engi-

neering Education Foundation which would provide permanently for a central staff organization was discussed and approved by the Council and a committee on Ways and Means with Dean A. A. Potter as chairman was appointed to handle the matter. This committee had two meetings during the past year and is making progress. Of course, this is such a large undertaking that it cannot be accomplished except by energetic work extending over a period of years.

In view of the activities of the Board and the able manner in which the Director of Investigations has directed the past investigations, the Board sent the following letter to Mr. W. E. Wickenden:

"May 16, 1928.

"The logical conclusion, and possibly the outstanding result of the investigation of which you have been a leader for several years past, is the realization by the members of this Society that this type of activity should be continued on a permanent basis for the promotion of engineering education. The work inaugurated by the Board has already developed the important study of the non-collegiate technical schools and their relation to industry and to the engineering schools. The Board wishes to take this opportunity of expressing to you its appreciation of the able manner in which you have directed the investigation. The success of this undertaking is due primarily to you and to your colleague, Mr. H. P. Hammond.

"You have expressed at different times to the Board your intention to sever your connections with this work on the completion of the original program. In view of this action of the Society at its last convention and in view of the present plans of the Ways and Means Committee looking toward the establishment of a permanent board through the creation of an engineering education foundation, we trust that you will not make commitments in another field. We believe that you may find in this new program a congenial opportunity for continued service and hope you will hold yourself available for a continuing relationship to the Society in case the plans originated by the Board of establishing an engineering foundation come through.

"As this letter has been submitted to the members of the Board and has their strong commendation it may be regarded

as an action of the Board and not merely the personal expression of its chairman.

(signed) "CHAS. F. SCOTT, *Chairman.*"

Lamme Award:—The will of the late Benjamin G. Lamme made the following bequest to the Society:

"I hereby authorize and empower my said executors and trustees to pay over to or place in trust for the Society for the Promotion of Engineering Education, or some other suitable body acting for the technical schools of this country (the beneficiary of such trust to be selected by my said executors and trustees), the sum of Six Thousand dollars ($6,000) of which an amount not exceeding One Thousand dollars ($1,000) shall be expended for a die and the balance shall be held as a trust fund, the yearly income from such trust fund to be expended for a suitable gold medal (together with a bronze replica thereof) to be given yearly to a chosen technical teacher for accomplishment in technical teaching or actual advancement of the art of technical training. If the accumulation of said trust fund, in the judgment of said beneficiary warrants, then in some years two medals may be given. No individual shall receive such medal more than once."

Due to the inheritance tax the Society actually received from the Lamme Estate, $5,160. The first medal will be awarded at this meeting.

The Council of the Society, in 1925, appointed a committee consisting of D. C. Jackson, Chairman, Charles F. Scott, Thos. E. French, and F. L. Bishop. This committee drew up regulations for the awarding of the medal and these were adopted by the Council at the Iowa State University meeting in 1927. This committee also selected the sculptor, Mr. Erwin Fry, of Columbus, Ohio, who designed the medal. The dies for the medal are in the keeping of the Medallic Art Company, 210 East 51st Street, New York City. By vote of the Council, the Society advanced to this fund this year $1,000 to pay for the design of the medal and for the dies. This will be returned to the Society from the income of the trust fund. $5,000 has been placed in a trust fund with the Forbes National Bank of Pittsburgh, Pa., the income from which will be turned over to the Society for the purpose

specified in the will. The report of the original Lamme Award Committee provided for a committee of twelve to select the recipient, this committee to be appointed by the President of the Society with the approval of the Council. The Committee appointed is:

Appointed for four (4) years:

C. S. Coler, Manager, Educational Department, Westinghouse E. & M. Co., East Pittsburgh, Pa.

O. W. Eshbach, Special Assistant, Personnel Department, American T. & T. Co., 195 Broadway, New York City.

W. M. Nelson, Executive Assistant, Industrial Relations Department, General Electric Co., Schenectady, N. Y.

Appointed for three (3) years:

H. V. Carpenter, Dean, College of Mechanics Arts and Engineering, State College of Washington, Pullman, Wash.

E. W. Rettger, Professor of Mechanics, Cornell University, Ithaca, N. Y.

R. S. King, Professor of Mechanical Engineering, Georgia School of Technology, Atlanta, Ga.

Appointed for two (2) years:

H. H. Jordan, Professor of General Engineering Drawing and Assistant Dean, College of Engineering, University of Illinois, Urbana, Ill.

B. F. Bailey, Professor of Electrical Engineering, University of Michigan, Ann Arbor, Mich.

C. B. Stanton, Professor of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

Appointed for one (1) year:

H. J. Hughes, Dean, Engineering School, Harvard University, Cambridge, Mass.

J. R. Withrow, Professor and Head, Department of Chemical Engineering, The Ohio State University, Columbus, Ohio.

F. B. Jewett, Vice President, Western Electric Company, 195 Broadway, New York City.

Tokio World Congress.—An invitation was extended to the Society to be represented at the meeting in New York, October 7, 1928, when this matter was being first introduced in America. We were represented at this dinner meeting by Past President George B. Pegram and Director W. E. Wickenden. This Congress is to be held in Tokio, Japan, in 1929, and any member who is planning to attend is requested to send his name to the undersigned. Professor D. C. Jackson is chairman of the Technical Program Committee.

High School Relationship.—Some years ago the Society considered the question of publishing a booklet for use in high schools which would give the student a better conception of engineering and the training which he would receive in an engineering college. The report on this was presented by Dean R. L. Sackett at the meeting in Washington and the matter was referred to a committee. I am bringing this to your attention now because of the fact that this agitation leads to the publication of a great many such booklets by different institutions. Many of these are excellent and give in a very clear way the fundamental facts which the high school student should have. They also fit the local conditions and in this way meet possibly the demand of the high schools. It is certain that these have been greatly improved and I doubt if it is now necessary for the Society to take further action in the matter.

REPORT OF TREASURER, W. O. WILEY

STATEMENT OF CASH ACCOUNT

June 20, 1928

Balance on Hand—June 17, 1927		$ 3,264.86
Receipts:		
Current Dues	$ 9,199.00	
Back Dues	736.00	
Dues in Advance	204.51	
Contribution from C. W. Gould	100.00	
Sales of Publications	3,633.47	
Advertising	2,132.65	
Interest, Exchange, Etc.	104.89	16,110.52
Total		$19,375.38
Disbursements:		
Cost of Publications	$ 9,518.06	
Cost of Proceedings	458.19	
Honorarium for Secretary	1,000.00	
Clerical Assistance—Secretary's Office (13 months)	2,799.92	
Traveling Expenses—Secretary's Office	122.69	
Postage, Expressage, Telephone, Telegraph, Sundry Printing and Office Supplies	786.25	
Expenses—Maine Meeting—1927	341.57	
Dues—American Council on Education—1927–1928	100.00	
	$15,126.68	
Payment of Balance of 1926–1927 Expenses (Dues—American Council on Education 1926–1927	100.00	
Prepaid Expenses—North Carolina Meeting—1928	184.52	
Lamme Medal Fund Expenses (to be repaid)	1,000.00	16,411.20
Balance on Hand—June 20, 1928		$ 2,964.18

Income and Expense Account

At June 20, 1928

for the year ending June 30th

Expense

Cost of Bulletins	$ 8,268.06
Cost of Proceedings	458.19
Expenses—Maine Meeting	578.67
Honorarium for Secretary	1,000.00
Clerical Assistance—Secretary's Office	2,599.92
Postage, expressage, telephone, telegraph, Sundry Printing and Office Supplies	786.25
Traveling Expenses—Secretary's Office	122.69
Dues—American Council on Education	100.00
Total	$13,913.78
Surplus for the year	956.67
	$14,870.45

Income

Current Dues	$ 9,341.00
Back Dues	736.00
Sales of Publications	2,658.91
Advertising	2,029.65
Interest, Exchange, Etc.	104.89
	$14,870.45

Balance Sheet

June 30, 1928

Assets

Cash:		
Current Fund	$ 2,964.18	
Petty Cash Fund	300.00	
Life Membership Fund	596.55	
Benj. G. Lamme Fund	499.70	$ 4,360.43
Securities:		
Benj. G. Lamme Fund		$ 5,000.00
Prepaid Expense—North Carolina Meeting 1928		184.52
Inventory		470.50

Accounts Receivable:		
Current Dues	$ 500.00	
Advertising	697.00	
Lamme Medal Fund	1,000.00	2,197.00
Furniture and Office Equipment		183.35
		$12,395.80

Liabilities

Life Membership Fund		$ 596.55
Benjamin G. Lamme Fund		5,499.70
Prepaid Membership Dues		304.51
Surplus Account:		
Balance July 1, 1927	$ 5,608.87	
Less: Reduction in inventory	470.50	
Total	$ 5,138.37	
Less: Payments for year 1926–1927	$ 100.00	
Net Balance July 1, 1927	$ 5,038.37	
Surplus for this year	956.67	5,995.04
		$12,395.80

THE SUMMER SCHOOL FOR ENGINEERING TEACHERS, A PRACTICAL STEP TOWARD IMPROVED METHODS OF TEACHING *

BY H. P. HAMMOND,
Associate Director of Investigation

As an introduction to this paper I shall reaffirm a statement made at the opening of last year's summer schools; my conviction that, no matter how important other factors in the situation may be, in the last analysis the real work of engineering education is done by the teacher in the classroom, and that no matter what the solution of problems of policy or of organization and administration may be, the problem of better teaching must be solved if engineering education, to quote that well known phrase, is to be developed, broadened and enriched. In that direction no more important step has been taken in the history of this Society than the establishment of its Summer School for Engineering Teachers which, I believe, is properly described by the topic assigned to me for this meeting: "A *Practical* Step toward Improved Methods of Teaching." In discussing the summer school I purpose to take the word "practical" as a keynote.

Objectives.—In planning the work of the school, as in any other undertaking, it is first necessary to have a clear conception of a definite aim toward which it is to be directed if any result that can be identified and measured is to be accomplished. That is particularly true of an enterprise which is so much of an innovation as the Summer School. Without a guiding principle the work might take so many directions, and we might so easily dissipate our energies following minor ends, that no one end would be achieved. It is possible, in fact because of inherent differences in various divisions of our curriculum we have found it to be inevitable, that there should be minor modifications of the particular things to be

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accomplished in the various sessions. It is also obvious that efforts to reach any particular objective will have important by-products. But in the summer school enterprise attention has been focused upon one main point—improvement of actual teaching methods—the process through which the teacher leads the student to mastery of the subject.

There are many elements that combine to produce improved teaching methods, ranging all the way from a better understanding of the ultimate purposes of engineering education and from better mastery of the subject on the part of the teacher, which I class as the first consideration, to minor classroom devices and expedients. Many of these elements are such that they can be identified, even classified, and attacked in our work. Others are not. There is much that is intangible in the teaching art, or so closely bound up in the individuality of the teacher as to be beyond the limits of training. The first task, then, is to select those elements which seem to be of greatest importance in producing better teaching methods, and to choose those that are susceptible of attack and with which the staff members seem capable of dealing. When one begins to prepare such a list, even if the aims be made quite explicit, it soon becomes a fairly extensive one. Assuming unlimited resources of men and money and unlimited time—a program of months instead of weeks duration, and sessions continuing over more than one year in a given subject—many of these objectives might be selected with some expectation of attaining them. But having in mind the inescapable limitations, the following have seemed to be the aims that should be selected at the present stage of the undertaking.

To define and discuss the fundamental laws of learning; the process through which new knowledge and new abilities are acquired.

To study the general principles which should underlie a sound teaching process.

To examine the relative usefulness of the several kinds of teaching procedure and to determine the conditions under which they may be combined to best advantage; i.e. what combination of lectures, recitations, and labo-

ratory exercises provides the best medium for the exploratory work, the drill, and the physical applications of a given subject.

In a given field to determine what elements of theory and practice are of primary and of secondary importance, and, having established the essential core of principles, to study its organization into a structural whole.

To learn something of the history of the subject—its origins and evolution—in order to provide a background from which to teach it.

To learn something of the technique of teaching; to see something of the art; and to study good and bad points of classroom practice.

To provide stimulus for the self-development of the teacher.

To do something in the way of giving a broader conception of engineering education and of our profession as a whole.

Through all of the work to develop a scientific attitude toward teaching problems and to further experiment and research in educational methods in our field.

Plan.—Having the objectives defined, the next step is the preparation of a plan. The general features have been presented to the Society on previous occasions, but they will be briefly reviewed and commented upon to make the picture complete. They are:

1. To relate the work to particular subjects in order to make it of as direct practical bearing as possible. We teachers of engineering have been referred to as "subject matter-minded." I suspect there is a considerable element of truth in that assertion. We, or many of us at any rate, are inclined to think of teaching, if not of engineering education in general, largely in terms of our own subject. I, for one, do not hold that this is wholly wrong; it is likely to make for intensive work in our own particular sphere of teaching, though it may lead to a "watertightcompartiveness" that is not wholly desirable. Taking the condition as it is, however, it seems very desirable to relate the various sessions of the school to particular subjects in order that what is learned about teaching may relate directly to what the teacher actually does from day to day. The selection of particular subjects also

brings together a group of teachers with common problems, who talk the same language, and meet on a plane of common interests. It is for these, as well as for other reasons, that it seems impracticable to solve our problems of teaching through colleges of education. The thought, rather, is to have them bring their aid to us and to fit their contributions into our plan.

By choosing different subjects in different years it becomes possible, over a period of years, to consider all of the divisions of engineering study and to have the influence of the school reach a considerable fraction of our entire group of teachers.

2. To hold the school in various institutions and parts of the country so as to make it as accessible as possible, and so that whatever there may be of benefit or burden to the local institutions may be distributed.

3. To provide both formal instruction through lectures, demonstrations and the like, and informal discussion in the nature of conferences or seminars. In this connection the plan provides for active participation by all of the members of the schools. It should be remembered that while some of the summer school groups are designated as staff, and that others are designated as members, in reality there is no such hard and fast distinction. An examination of the lists of staff and members will make it clear that such a distinction should not be drawn.

4. To provide opportunity for purely informal exchange of information and ideas ("bull sessions" as they came to be known last summer) and thus promote a better understanding of the conditions in engineering education in various types of institutions and parts of the country. It is also the definite purpose to promote an *esprit de corps* among teachers in a given division of the curriculum. This part of the summer school enterprise deserves careful consideration. We feel it to be a very important element in the whole plan and we have studied ways and means of promoting it with just as much care as we have planned the formal features of the work. I rather imagine that those who attended last year will agree that it had very real and lasting values.

Program.—Other features of the plan are best shown by a brief study of the actual program of one of the sessions. Before doing this let me repeat that the programs must and should vary to some extent to accord with the subject or division of the curriculum being considered. What might be an entirely appropriate set of topics of discussion for such a subject as mechanics, for example, would not be appropriate, except in part, for a session on graphics or English. Certain general features, of course, are suitable for all programs, such as the general principles of teaching, and there should, as already said, be a common general purpose. As an illustration of the program of one session I call attention to that in physics, which has been selected more or less at random. This program was constructed in accordance with the following outline, which it will be noted, follows closely the statement of purposes in a foregoing paragraph:

I. Teaching methods in general. (In charge of the Educational Adviser.)
   - *a.* Laws of learning.
   - *b.* Principles of teaching.
   - *c.* Student personnel problems.
   - *b.* Teaching procedures.
   - *e.* Examination methods.
   - Etc.

II. Teaching methods in the particular subject. (In charge of the full-time staff.)
   - *a.* As related to major divisions of the subject, e.g. mechanics, heat, electricity and magnetism, etc.
   - *b.* As related to different kinds of class exercises: lectures, recitations, laboratory periods, etc.

III. Coordination of the subject with other divisions of the curriculum.
   - *a.* Preparatory subjects.
   - *b.* Related subjects running concurrently.
   - *c.* Subjects prepared for.

IV. History of the subject.

V. Advanced phases and applications.

VI. Inspirational lectures, recreation, etc.

The relative time devoted to these divisions is about as fol-

lows: teaching methods in general, one-sixth; teaching methods in the subject, one-third; advanced phases and applications, one-sixth; coordination and history, one-sixth; inspirational lectures, recreation and miscellaneous items, one-sixth. It will be noted that teaching methods in the particular subject receive greatest attention, and that this is followed by teaching methods in general and by applications and advanced phases which are given about equal attention. This, I believe, is as it should be. In engineering education, and in other professional fields as well, method and subject matter are inextricably interwoven. As one of the staff, I think it was Professor Rettger, said last year, "There is method in a subject." He meant, I presume, that after a subject has been through a long continued process of development and evolution; after it has been taught by a great many teachers; and after many books have been written on it, each combining to a certain extent the contributions of predecessors and the additions of the author, there must have grown up an orderliness of arrangement and a system designed to assist the learner to assimilate the new ideas involved which do, in themselves, go a long way toward constituting a method. Certainly, I believe, this has come to pass in such subjects as mechanics in which there seems by unformulated agreement to have come about a very considerable uniformity of method of instruction which accords with the aims now sought in that subject. Further, what to teach *is* important in engineering. Discussion of methods should, I firmly believe, be directly related to the subject taught.

Aside, however, from methods as applied to particular subjects, there are certain principles of education which underlie the whole field, irrespective of the particular division involved. It is these that are to be considered in the first division of the program. We propose to begin by considering the laws of learning—the ways in which new knowledge and abilities are acquired—not in a technical or abstract way, but so that the points considered have a direct bearing upon what we do from day to day in the classroom. I might illustrate what I mean

by citing my own experience at one of last year's sessions. I found that because I knew little or nothing about the way in which we forget that I had been disregarding a very elementary principle of teaching in the way I had arranged advance and review work. According to this principle, the time to give a first review of a new principle is while the subject is still fresh in the student's mind, before the steeply descending part of the curve of memory is reached. As a result I have revised my method in hydraulics to the extent of giving a brief review of each assignment at the beginning of the next period. I have not abandoned the general review at the end of the term when the entire subject is covered so as to give the student not only mastery of its details but also a comprehensive understanding of it as a whole, but I have instituted the practice of the brief daily review and the requirement that each day's work include the assignment of the preceding day, with a perceptible gain in the effectiveness of the work. This has been done at some small sacrifice of subject matter covered, and I am really glad that it has. In future there will be less of the superficial and hasty skimming over a good deal of ground by my students; what they learn will be driven home while it is still fresh in their minds.

Based on this study of the laws of learning there will be consideration of the principles of teaching. This involves selection of the ends to be achieved and the methods of achieving them. There will be discussion, for example, of what proportionate emphasis should be given to the development of skills, the imparting of knowledge, the ability to do creative work, and the development of appreciation. Under this heading comes not only the development of a plan for the subject as a whole but also the planning of lesson periods. It is the purpose here to consider the principles which underlie these matters rather than the details of presentation of subject matter, the latter being included primarily in the second division of the program.

Time does not permit of a further discussion of these points, but I would add that we are taking the utmost pains to place

the work in the hands of educational advisers who, by reason of their breadth of knowledge and sympathetic attitude toward our problems and their willingness to meet us on our own plane of interests, will deal with the principles of education in such a way as to yield definite values to engineering teachers. From such men I believe that we have much to learn concerning the principles of the profession of teaching and that we can do much to improve our methods by bringing them into accord with well established laws and demonstrably sound procedures.

Other features of the program are explained to a considerable degree by the topics listed in the copies that have been distributed. Experience has already guided us in planning the work and will undoubtedly be even more of a guide as it proceeds.

Future Developments.—A great deal might be said of the possibilities of further development of the summer school enterprise. Tentative plans for 1929 have already been begun. An invitation to hold a session of the school at one of our leading universities has been extended and if things go as now anticipated it will probably be accepted. For next year efforts may be concentrated upon a single session devoted to one of the major divisions of the curriculum. To illustrate the type of program that may be used, it may be supposed that mechanical engineering is chosen. A part of the meetings, perhaps one-third, will be devoted to the study of topics bearing upon mechanical engineering in general and of importance to all of its teachers. The remaining parts will then be divided under three heads—heat power, machine design, and management or shop practice. The general meetings will be in charge of the local staff leader and will be conducted by him, by the educational adviser on matters of general educational import and by the other members of the staff in discussions of a general nature. The divisional meetings will be presided over by three groups of teachers dealing with the three divisions mentioned. Coupled with the general and divisional meetings it is possible to have one or more series of

lectures by eminent teachers or scientists on particular subjects; for example, a series of lectures on heat power engineering giving in from ten to fifteen periods of two hours each a general summary of the subject and also some of its further developments with which the progressive teacher should acquaint himself. In the hands of a master of his subject, one who has the gift of vivid presentation and of selecting the points of salient importance, it is not difficult to picture the value of such a series of discourses delivered before a group of men having a vital interest in the subject. In the fields of heat power and machine design it is not difficult to select men in this country or from abroad who possess these qualifications.

If this general plan is adopted it is probable that the limit of attendance will be considerably raised so as to provide three groups of perhaps twenty-five men each, a total of seventy-five for the entire conference. This would spread the benefit of the work among a larger number without sacrificing anything of the values of intimate association of teachers interested in particular subjects.

In the fairly near future it will also be advisable for us again to take up subjects already considered, such as mechanics. If this is done the program will probably take somewhat different directions from those of last year and through a plan to be discussed presently it will be possible to provide not only for discussion of teaching methods but also for an intensive review of analytic mechanics for those who desire it and advanced work for others.

The same principle of cooperative effort that has guided the general investigation from its start is applied in the summer schools. We look to the Society's membership and to the colleges for active participation. In particular, the selection of subjects or divisions of the curriculum for consideration at future sessions will undoubtedly be influenced by the interest and the initiative displayed by the teachers of the subject; such, for example, as the initiative being displayed by the teachers of graphics. The decision between two subjects this

year was reached because the teachers of one of them displayed initiative and gave clear indications of their active cooperation. The matter of probable attendance will also, of course, always be a factor, and the more definite the assurance of adequate numbers can be the more likely it is that a subject will be chosen. It should be said in this connection that we are keeping in mind the advisability and the possibility of devoting sessions to consideration of the humanistic subjects, particularly English and economics.

Coordinated Activities.—The period of the Summer School is relatively brief and probably could not be made very much longer without serious loss of attendance, though there is nothing hard and fast about the three-week period thus far used. It is not necessary, however, to confine the work of the schools entirely to the duration of the sessions. Coordinated researches and studies can be made either before or after the summer. Such studies might fall into either of two principal groups, one relating to teaching methods in general and the other to particular subjects.

An excellent example of the possibilities in the first group is afforded by the study of learning rates reported by Professor Curtis at the Orono meeting of the Society and by Professor Woodward at the Wisconsin session of the Summer School last year. Among other possibilities may be mentioned a study of examination methods including the use of the so-called objective types of questions, a study of the results of sectioning on the basis of ability, a study of the relative effectiveness of various practices in coordinating laboratory with recitation work, a study of what may be called the demonstration method as contrasted with the individual laboratory test, and the like. Such studies would differ, of course, to a considerable extent but in common they would relate to the learning or teaching process primarily and to the particular subject only secondarily. Such studies reported upon and studied at the summer school would furnish the basis of a scientific analysis of some of our difficult problems.

An illustration of a type of study which would work in ad-

mirably with Summer School, one having a definite bearing upon the particular subject only, is afforded by that undertaken by Professor C. V. Mann in testing aptitude for and achievement in drawing courses.

Still another illustration of the type of coordinated investigation in the second group above mentioned is given by the possibility of conducting an intensive study of the purposes, organization, content and methods of shop courses. The aim would be to clarify conceptions of the ultimate objectives of shop courses and to determine the principles upon which they should be organized and conducted. The study might even go so far as to determine upon the types of problems and exercises best adapted to the ends sought. Such a study might be made under the general guidance of a committee of teachers and administrators concerned with shop work and in charge of some one man selected to conduct it.

Another type of coordinated enterprise would be in the field of the history of the subject. This might be done through seminar groups of teachers or of graduate students under the leadership of an interested professor. In such a study the original sources of historical data could be consulted, monographs prepared on particular epochs or stages in the development of the science.

The words *would* or *might* have been used in these remarks because plans have not gone so far as definite proposals. A number of important problems must be solved before they can be made definite. The illustrations will serve, however, to show some of the special developments that are possible. It is my hope that some or all of them may be realized. They point clearly to the desirability of placing the schools on a permanent footing. If any one knows of a better opportunity for an endowment permanently to benefit engineering education, excepting only for an increase in the scale of teachers' salaries all along the line, I have yet to hear of it.

Courses for Academic Credit.—One other possible development of the Summer School should be mentioned—the offering of related courses leading to academic credit by the institu-

tions which act as hosts. The Society is not empowered to confer such credit but we might arrange in connection with a session on, say, mechanics to have the local institution offer courses for academic credit to our teachers which would run either concurrently with our work or after the sessions end. It has also been suggested that intensive review courses covering the content of the ordinary undergraduate course and some of its advanced phases be given, and there is some reason to believe that there is a demand among the teachers for them.

It is possible, in fact probable, that as an outgrowth of this year's session a start in such coordinated courses for advanced credit may be made next year through special summer courses for teachers of physics to be offered by the Massachusetts Institute of Technology.

Publications.—Last year a comprehensive report on the sessions on mechanics was published with the purpose of giving a clear indication not only of the general nature of the school but also of the subject matter of each day's proceedings. I may say that the preparation of the bulletin was a laborious job, not only for our staff but also for the secretaries of the sessions—too laborious to be undertaken each year without additional staff. That bulletin seems to have served its purpose and the occasion for repeating it probably does not exist this year. The plan will probably be to issue a series of monographs of contributions by members of the staff which have outstanding merit. These will probably be of several kinds, one set relating to educational principles, one to the history of the subjects, and another to teaching methods in the particular branch of the curriculum. They will be made available at a cost such as to promote widespread circulation and can, if desired, be made the basis of faculty conferences, seminars or individual study. As in other features of the work experience will guide us in planning a program of publications.

Guidance of the Younger Teacher.—There is one point in connection with the Summer School, not relating to any part of it in particular but to the undertaking as a whole, that I wish to mention, for I have a particular interest in it. It is the

matter of aid and guidance of the younger teacher. I do not know what the experience of others has been, though I suspect in many instances it has been much the same as my own. I have a vivid recollection of my first year in teaching, which followed immediately after graduation. In that year I did not have (nor have I as yet had, for that matter) one single word, unsought by myself, of advice or guidance or criticism as to how I should conduct my work. That first year I taught hydraulics, public water supplies, descriptive geometry, sanitary design, hydraulic laboratory, materials testing laboratory, drawing, and, during the summer, surveying. And it was not merely assisting some one else to teach but doing the actual teaching myself, sixteen or eighteen hours a week of it in the classroom in charge of a section. Talk of throwing a man overboard to teach him to swim! Now I will not say that the result was wholly bad, for I learned some things that year. In particular I learned more of subjects than I ever as an undergraduate suspected there was in them. But I wonder whether it was a defensible procedure from any point of view, and whether it was fair either to the students or to me. It would have been a very simple matter to give the three young teachers who started out in the department that year some suggestions and guidance, but nothing whatever was done. In no other way do I think we err more grievously than in the handling of our younger teachers. Almost nothing is done to guide them, to say nothing of anything to inspire them. I speak in general, of course, and not of the exceptions. Incidentally I may say that experiences similar to mine were cited by many of the teachers who attended last year's sessions.

If in no other way than this the Summer School promises to serve a purpose making it fully worth the cost. To the sessions can and do come both the beginning and the experienced teacher. They are thrown into intimate contact for a period with nothing to do but to think and talk and live teaching. Each is bound to absorb from the other to the profit of both. In the regular sessions the younger man may learn something

of the principles of his daily job, he may see presented and dissected the methods of some of our ablest teachers and he may review again the elements of the subject he presents. In the actual classroom he can sit as an auditor and observe the way others present the subject he teaches, and he may then hear the method discussed from many angles. If for no other reason, the Summer School should be continued for what it may do by way of orientation and guidance and stimulation of the younger teachers, who are the professors and the deans of the future.

Conclusion.—The sessions of 1927 and, to a certain extent those of 1928 have been experimental, but apparently the summer school enterprise has proved its worth. Its future seems to depend entirely upon the possibility of financing it. The organization, the facilities of men, the willingness of the colleges to cooperate and the demand among the teachers all exist. If the funds, preferably through an endowment, can be obtained the summer school enterprise promises to take its place permanently in our field.

I can not close these remarks without expressing a genuine feeling of pleasure and gratitude for the devoted service of the numerous members of the teaching staffs, for the cordial hospitality and the cooperation of the colleges that have received the school and for the generosity of the donors who have supported them.

DISCUSSION

E. R. Maurer, University of Wisconsin: This is a very clear picture of the summer schools which Mr. Hammond has drawn for us. His ideals are very high in my opinion, but I believe his intense practicality will lead him to a full realization of those ideals. I was very much interested in the coordinate activities that he referred to in his paper, especially the activity which he called Historical Studies. I believe studies of that nature will not only lend interest when they are once worked out, but will be of great value in many instances to our students in establishing subject matter here and there.

I have one illustration in mind in my own field, and I dare

say there are some here who have had trouble in getting satisfactory answers on what the moment of inertia is. There are teachers of the subject of Engineering, I would say, who have studied it, and it is a puzzling topic. They have worked out more or less original explanations. I recall one that was worked up by a teacher of engineering. He published the results of his studies in the transactions of the American Society of Mechanical Engineers, about thirty or thirty-five years ago. When they first came to my attention, I felt sorry for any student who read the results of those studies. Instead of throwing light on the subject, I think he obscured it, and many who took part in the discussion of that paper were of like opinion. I refer to J. B. Johnson, R. S. Woodward, S. M. Woodward, Professor Church, and men of eminence in their field.

It seems to me, anybody who makes a study of the history of that term or that subject, will understand and can make his students understand with very little effort, what those things mean. No such person would take the trouble and make such a futile explanation as the one to which I refer. A number of like character have appeared from time to time since then. I think there are other subjects on which light can be thrown.

There is another field of activity which I was pleased to hear Mr. Hammond mention. That is the last one he referred to, in referring to his own experience in teaching. I doubt very much whether his own experience is exceptional. I am inclined to think that the older ones of us at least, have had some similar experience. Conditions are getting better I am sure, but there is much room for improvement. I had occasion a couple of weeks ago to inquire of a group of men what was being done in that direction in any way in university teaching. The first man I approached on the subject said that supervision of teaching in colleges and universities is coming, and coming rapidly, and will be with us very soon. I have consulted with a colleague of his and he agreed very strongly. I asked him whether any supervision was made at the University of Wisconsin or not. He said not that he

knew of. I asked if anything was being done in that line in the Department of Education, of which he was a member. He said yes, but nothing of what you would call foreign. Considerable assistance, however, is being given in that department to younger teachers. I learned also in a sister university, that supervision of that sort was getting rather common. So I think I can safely comment on supervision of younger teachers as coming sooner or later, and I should like to see engineering schools not lag behind in that respect. I hope that the various coordinate activities may be pushed so that we can get the benefit of them right soon.

Leroy Tucker, Clemson College: Last year in July the venerable Society for the Promotion of Engineering Education became the godmother of lusty twins, the Cornell and the Wisconsin Summer Sessions. Like *Romulus* and *Remus* of Roman history they may be the precursors of a mighty race that is to follow. Like lusty youngsters usually are, these twins were termed by some *howling successes.*

As one of the chief howlers while the Wisconsin, or Remus twin, was first testing out its lungs last summer, I offer that as an excuse for discussing Professor Hammond's very full presentation of the history, development and future plans for the summer schools. From all that has been told I have chosen only three aspects upon which to comment:

1. The guidance of the young teacher,
2. The use of the educational adviser, and
3. The published reports of the schools. (These last not mentioned by Professor Hammond.)

While the beginning teacher may not be thrown overboard as of yore yet he and some others of his fellows may feel just as much at sea. I have in mind these men:

1. The very young beginner at teaching.
2. The lone teacher in a one-man department.
3. The teacher in the smaller school who must teach some other subjects than his own specialty.
4. The professional engineer who takes up teaching rather late in life.

To many of the above men the Summer Sessions are a veritable god-send. To quote Professor Hammond, "To the summer school can and do come both the beginning and the experienced teacher. They are thrown into intimate contact . . . each is bound to *absorb* from the other."

To relate my own experience at the summer school I took *absorb* as my motto, the *sponge* as my ideal. I took in all that I could at the scheduled meetings. There was plenty there to keep every one quite busy. Everything went off so smoothly that one would have thought that Professor Hammand had been organizing, and Professors Maurer, Poorman, and Woodward running such things all their lives. I was not content with this only. I trailed Professor Poorman around until I am sure he grew tired of it. I annoyed Professor Woodward on countless occasions. I tried to study Professor Maurer whenever I saw him. I was trying to find their methods and ideas but most especially their characters. I found others not on the program to be veritable gold mines of ideas. I made a ten-strike when I became acquainted with Professor Brooke. Among the younger teachers, Professors Becker, Folk, Campbell, and Wegner, I found were full of useful information.

It was not an even trade however. I came away chuck full of notions, many of them exactly suited to my teaching problem, my sort of students, my own individuality; but unfortunately I could not give much in return. A professional engineer who turns teacher cannot help another teacher much. I could tell them of Paul Bunyon but not much about Galileo or Pythogones.

The matter of educational adviser seems so well entrenched in Professor Hammond's fundamental ideas for the school that I may be taking my life in my hands by questioning it, but I will offer this quotation of Professor Hammond's:

"In engineering education and in other professional fields as well method and subject matter are inextricably interwoven. . . . What to teach *is* important in engineering. Discussion of methods should be directly related to the subject taught."

Until there can be found an engineer who understands education as talked by the professional educators or else a professor of education who understands engineering to act as a sort of interpreter, the practical use to be had from the educational adviser is bound to be limited.

The last phase of the subject which is supremely PRACTICAL is the matter of the reports of the schools as published in the Journal.

In the limited time one had at the school to stop and to digest the material which was presented to us, the significance of much of it escaped me. When, however, the reports were published lots of good points appeared that I had failed to grasp before that time. By reading over the reports of the Cornell session I found most that our twin brother, Romulus, had done and said. The longer formal papers were all worth *re-reading*. For example, I had always wanted to give my students some more of the historical background and more of the personality of the great names in mechanics and allied subjects. By taking Professor Rettger's paper on "Mechanics before Newton," presented at Cornell, together with Dean Slichter's paper on "The Life of Newton," and Professor Maurer's "History of Text Books," presented at Wisconsin, I had a rather complete history of the subject right up to modern times. I have used this in class, mostly for those dull Saturday morning classes following some major social engagement indulged in by the students. I think that to many of them has been brought a new interest in and a more personal relationship with mechanics.

I believe my teaching has been made better. I owe it to the S. P. E. E. Summer School.

T. F. Hickerson, University of North Carolina: Mr. Hammond has outlined the summer school enterprise—its objectives, plan, and future programs—in a manner so clear and comprehensive that I shall not attempt to give anything further except a few words bearing out my hearty approval of the scheme as a whole.

My experience gained from attendance at the Cornell session

during the past summer leads me to attest to the fulfillment, to a degree, of all the aims, which as stated by Mr. Hammond, are focussed upon one main point—improvement of actual teaching methods. I feel certain that if all those in attendance at the Cornell and Wisconsin sessions were to take stock now of their teaching results during the year, the report would indicate better success than had ever before been attained; for doubtless every person in the above groups went home with the determination to obtain a better grasp of his subject and to continue to *adopt, reject,* or *never try* certain teaching procedures, whose effectiveness or ineffectiveness had been convincingly demonstrated either formally in the lecture room or informally at group gatherings.

As to the program outlined for future schools, the only adverse comment I could possibly make is this: Considerable emphasis is given to teaching methods in general under the direction of an Educational Adviser who is presumably unfamiliar with the particular subject at hand. A little of this seems highly desirable, but I am wondering if as much as one sixth of the total time should be so allotted.

In closing I wish to express the hope that these summer schools can be continued indefinitely; and I think much credit is due Mr. Hammond for inaugurating this really forward step in engineering education.

W. J. Risley, Colorado School of Mines: Assuming that the general contents of Mr. Hammond's paper, which I had the privilege of reading for the first time last evening, would meet with discussion by the other members, I have chosen to talk beside his paper rather than through it.

My remarks may be under the head of what I conceive to be the increasing challenge. A friend of mine on the birth of a second son sent off due notice of the event, and sent a notice also to a former professor. He replied in a wire, saying, "I hope you may raise the boy to stand the strain of his own generation."

I believe that is our job, to raise the boy to stand the strain of his generation of activity, to stand the strain of that ac-

tivity and to enlarge the field of usefulness and to raise the next generation to stand the strain and extend the phase. There are a good many things that come along that way. It will be noticed that recently the fiftieth anniversary of the making of the first dynamo electric machine was celebrated. Incidentally I found that they are two years too late. And today and tomorrow, they are using high frequency voltages, current of 25,000,000 alternations per second, in an attempt to study more of God's nature, the ultimate source and nature of energy.

In twenty-five years, the world has been transformed from a universe of separate places into a single neighborhood. And what of the future and the game that the youngsters with whom we deal have ahead of them and ahead of us?

In a little confessional meeting in Chicago recently, Professor Michaelson described himself as the sailor who degenerated into a college professor, and confessed that it was no love of humanity that had made him a scientist. He turned from the sea to science because it thrilled him to match his wits with inanimate objects. His greatest joy he says, is accomplishment. His greatest inspiration is the challenge to attempt the impossible.

A change has taken place over the years even in the attitude of mind which the great industrial concerns have, and the items which they desire to sell in their advertisements to people. I have here two typical texts. They are advertisements of the Western Electric Company. Some of you may know them, "Where Good Enough Isn't," and that is our job, where good enough isn't.

This one is headed, "Was there ever a good enough stroke?" Was there ever a winning crew or, in the business world, a progressive industry perfectly satisfied with itself on coordination? And this one with the same theme, "The baseball team that is never satisfied with its performance is headed for the top," and in this as in the making of telephone apparatus, success follows the determination of every man to cover his position and to work in harmony with his team mates. And

this one, "The sax wails, the brass blares, the drum's deep voice speaks, yet all in perfect harmony when every player puts his best into the part."

The next one, "When mass cheering and singing to be truly effective nowadays must be well organized." Ask any cheer leader how long he thinks the "good enough" cheering of a few years ago would get over today. And then there is the theme of another company, the Westinghouse. Each of these illustrate it. This is the theme in each month's bulletin or each month's magazine of the Westinghouse, "Where do young college men get in a large industrial organization?" "If there are opportunities to exercise creative talent, is individual work recognized?" Then they picture in connection with their ad, younger college men on recent Westinghouse jobs, a challenge to you and to me, which we should pass on to the boy under our care and our training, a challenge by a company which seeks the development of the men who is to do something beyond the formality of his job or the strain of his generation.

These are things that are not in books, these are things that are not in subject matter, these are spiritual things that are a piece of the job of engineers and of engineering teaching and of engineering practice, the challenge that comes to a lubricating oil to take care of the intense strain under which high rotating parts and great stress must come, the challenge which the airplane brings to you and to me to determine relatively by new laws that must be extended beyond the old scope, a new basis, new items of strength and material, new advances in the line of elasticity, that is our job, yours and mine, to get through and into and over to the boy under our training, the item that will permit him to measure up to the strain of his generation.

A CONFERENCE ON ENGINEERING MECHANICS IN 1929

As a result of the 1927 Summer School on engineering mechanics, two brief sessions for the purpose of discussing this subject were held during the annual meeting of the S. P. E. E. at Chapel Hill in June, 1928. At the second of these sessions, those present voted to hold a more extended conference, to last about one week, either just before or just after the next annual meeting of the S. P. E. E. to be held at Columbus, Ohio, in 1929.

Professor A. P. Poorman, chairman of the standing committee on mechanics of the S. P. E. E. has appointed the following committee to make preliminary arrangements for the conference: Sherman M. Woodward, chairman, J. E. Boyd, S. B. Folk, E. R. Maurer, E. W. Rettger, N. C. Riggs, and A. P. Poorman, ex officio.

Object of the Conference.—To provide an opportunity for a full and untrammeled discussion of a considerable number of fundamental and important questions relating to the teaching of engineering mechanics. The experiences of the last two years have shown that there is a great diversity of opinion among engineering teachers regarding the aims of the study of mechanics, the content to be covered, and the methods of teaching. At the ordinary convention meetings there is inadequate opportunity to thresh out differences of opinion. It is hoped that, at this proposed conference, diverse views may be reconciled somewhat, that where strongly opposing views are held the various attitudes may be developed and made perfectly clear and may be fully supported by facts and arguments, and that the essential results of the discussions can be put in form for publication. If a clear-cut and complete statement of the fundamental principles and practices that ought to be applied in the teaching of this subject can be compiled, it should be of great benefit to teachers throughout

the country. It is hoped, furthermore, that if irreconcilable views on important matters are developed, some sort of research program of observation and experiment may be evolved to help resolve the debatable questions.

Topics for Discussion.—The following are some of the topics that have been suggested for discussion:

Objectives in mechanics.
Minimum content of subject matter.
Standards of passing.
Classroom methods.
Objective examinations.
Best preparation of teachers.
Should students be sectioned on the basis of ability?
When restricted time necessitates an abbreviated course, what parts should be omitted?
How much of mechanics should be committed to memory?
Should the mechanics course be used definitely for securing review of arithmetic, algebra, trigonometry, analytic geometry, and calculus?
What should be the relation of mechanics to elementary physics?

All persons interested in this field are invited to send suggestions to the undersigned.

SHERMAN M. WOODWARD,
Chairman

IOWA CITY, IOWA

THE 1929 SESSION OF THE SUMMER SCHOOL FOR ENGINEERING TEACHERS

BY H. P. HAMMOND,

Associate Director of Investigation, S. P. E. E.

At the June, 1928, meeting of the Board of Investigation and Coordination, the invitation of Purdue University, extended through Dean A. A. Potter to hold a session of the Summer School for Engineering Teachers on its campus during 1929 was accepted on behalf of the Society. Mechanical engineering was selected as the subject for the session. But one meeting of the school will be held in 1929, instead of two as formerly. Dean Potter will be in charge of all local arrangements and will cooperate with the Headquarters Staff in planning the program and conducting the meetings.

Purdue offers a central location, readily accessible to teachers of most of the engineering colleges and will provide unusually good facilities for housing the group. One of the new dormitory units on the campus is to be set aside for that purpose. Meals as well as rooms will be provided for the entire group in the same building.

Tentative plans for the program follow the general lines described by the writer on pages 109 to 121 of the present number of the JOURNAL. Particular attention in planning the work is to be given to general educational matters in charge of the Educational Adviser, though the time devoted to such matters is not to be increased. It is hoped to relate this portion of the work closely to the problems connected with the teaching of mechanical engineering. It is planned, at present, to conduct a part of the program in three divisions meeting simultaneously, one devoted to heat power engineering, one to machine design, and one to production and management. Instruction in these three divisions of mechanical engineering will be given by leading engineering teachers, and will be

supplemented by specialists from industry. It is also hoped to have one series of lectures by an eminent authority on one of the basic subjects of mechanical engineering curricula, probably thermodynamics.

The limit of attendance will be increased to approximately seventy-five with the expectation that there will be three groups of twenty-five teachers each in the three divisions mentioned. If the experience of the past two years is any guide, there will be more applicants than can be accepted and this notice of the session is published thus early so that teachers can make their plans in advance. Letters of application or inquiry should be addressed to the writer at 33 West 39th Street, New York City.

THE INVESTIGATION OF NON-COLLEGE TECHNICAL EDUCATION

BY W. E. WICKENDEN,

Director of Investigation, S. P. E. E.

The December issue of the JOURNAL announced that the Society had received a special fund for a study of a more intensive type of technical education than that given by the engineering colleges. It is difficult to define the scope and aims of this investigation in a simple phrase or title, for the reason that there is no widely accepted designation for either the schools, courses or type of education in question. One can approach a definition or specification by a process of elimination. It is not a particular type of school or course that is to be studied, but rather a type of education in which schools of several varieties participate to some extent. This type of education is non-collegiate, in the sense that it is less than four years in length and does not lead to a degree. It is not a course in a junior college, in the ordinary sense, since it is intended to be a terminal program complete in itself and neither a truncated section of a longer program nor one preparatory to more advanced study. It is not secondary education, but is distinctly more advanced than the work done in the usual high school. It is not trade education, in that it is not intended to serve as a substitute for apprenticeship and does not aim primarily to make the student proficient in some specific craft or industrial function. So much by way of elimination.

On the more positive side, the following characteristics may be stressed. The type of education in question is definitely technological in content; it is more practical in aim and more direct in method than the usual instruction of the engineering colleges; it is based on a connected curriculum rather than small, unrelated units; it is at least one school year or its

equivalent in length; and it is closely related to the student's present or prospective field of employment.

When a comparison is made between technical education in America and in other industrial countries, the most striking fact is the extreme concentration of our efforts in degree-granting colleges. In Great Britain, on the other hand, there are fourteen universities which award degrees in engineering, one of them having several affiliated colleges which might be counted as separate units, but there are more than one hundred and fifty "local technical institutions" which provide technical education of a more direct and intensive character. Germany has eleven technical universities and two mining academies of like rank, while the number of higher industrial schools probably exceeds one hundred. The European scheme has some elements of social stratification which are uncongenial to our traditions and which no one wishes to transplant. It seems certain, however, that the greater variety of schools and programs abroad does result in a better balanced recruitment of industry and does afford a more democratic range of opportunities for persons of differing tastes, circumstances and abilities. The colleges and universities, both here and abroad, adapt their instruction to general rather than local needs, while schools of a more intensive type are often able to fit their work more closely to the needs of their immediate communities and the surrounding industries.

The preliminary work of organization and reconnaissance has been practically completed and the active work of investigation is under way. The work has been mapped out in three divisions:

1. The study of industrial requirements.
2. The study of educational organization and methods abroad.
3. The study of present schools and methods in the United States.

The first of these divisions has been placed in the hands of Mr. Robert H. Spahr, who brings to the work an unusual background of experience. Mr. Spahr is a graduate in engineering of Washington and Lee. Before joining the staff he was

in charge of the division of employer-employee relations in the department of manufactures of the U. S. Chamber of Commerce. His teaching experience has included public schools, universities, and engineering extension division and a technical school within the field of this study. His industrial experience has included both engineering and personnel responsibilities.

The writer will cover the second division of study within the fall months, sailing on October 4 and returning about the middle of December. Most of the contacts for this new study were set up during the earlier studies of the European engineering schools. This visit will afford opportunity for rechecking and completing some of the data of the former study before its final publication.

The third division will be shared by the writer with Dr. John T. Morris of the division of educational research at the University of Pittsburgh. Dr. Morris was formerly Director of the College of Industries at the Carnegie Institute of Technology and holds his doctorate in education from Columbia.

An advisory committee, in which the several groups of interests affected by the study are represented, has been established under the chairmanship of Mr. Frederic B. Pratt, president of Pratt Institute of Brooklyn. It is expected that this committee will meet near the end of the present month to review the plans of the staff. The study is to be completed and the report published about the first of September, 1929.

MINUTES OF THE COUNCIL MEETINGS

Present, President Sackett, F. L. Bishop, B. M. Brigman, G. M. Braune, S. S. Edmands, T. E. French, A. M. Greene, S. A. Harbarger, H. P. Harmond, A. C. Lanier, O. M. Leland, C. V. Mann, G. B. Pegram, A. A. Potter, R. I. Rees, R. A. Seaton, C. F. Scott, F. E. Turneaure, W. O. Wiley, S. M. Woodward, C. E. Magnusson, C. M. McKergow.

The following actions were approved:

C. C. Williams, W. B. Gregory and A. E. Morgan were appointed members of the Committee on the Lamme Award for a term of four years. G. H. Pfeif was appointed for one year to fill the unexpired term of W. M. Nelson.

The Ways and Means Committee reported that three meetings had been held during the year but that they were not successful in bringing about the program which they had in mind. The Council approved the project to obtain an endowment to yield a minimum of $50,000 per year.

C. F. Scott, Chairman, reported for the Board of Investigation and Coordination.

D. S. Kimball was appointed a member of the Board of Investigation and Coordination for a term of five years—his present term having expired.

R. L. Sackett was appointed a member of the Board to fill the unexpired term of M. E. Cooley who resigned.

Invitations were received to hold the 1929 meeting at the Ohio State University, Lafayette College, Syracuse University and the University of Missouri. The invitation of the Ohio State University was accepted and the 1929 meeting will be held at that institution.

C. M. McKergow of McGill University, invited the Society to hold its 1930 meeting in Montreal. Motion that the invitation be received and that the Secretary be instructed to write the appreciation of the Council and that the invitation be given consideration in due time.

H. P. Hammond reported the progress of the 1928 summer school for engineering teachers at the Massachusetts Institute of Technology on Physics, and at Pittsburgh on Electrical Engineering. He also reported an invitation from Purdue University to hold the 1929 school at that institution and that mechanical engineering would be the topic of the meeting.

The dues for individual members, which have heretofore been $4 with $1 assessment, were raised to $5 per year.

The question of dues for institutional members was referred to the Institutional Division and the members of this Division voted unanimously to raise the dues to $15 per year.

Council recommended to the Society that By-Law four of the Society be changed to read "The annual dues shall be $5 for individual members, and $15 for institutional members."

Many suggestions were offered at the request of the Editor, for increasing the value of THE JOURNAL OF ENGINEERING EDUCATION. Some of these suggestions were:

The Director of Investigations and his staff would maintain a section of four or five pages in each number and give in this section a fairly brief abstract of papers appearing in the educational press which are of significance to engineering education.

Enlarge college notes.

Bring out contributions from members who, through modesty, might not be brought to the attention of the Editor. Members knowing of such papers should bring them to the attention of the Publication Committee.

Print employment notices.

All of the above suggestions were referred to the Publication Committee.

T. E. French, Chairman of the Committee on Drawing and Design presented the following resolution from the conference of teachers of those subjects:

"*Resolved:* That the Council of the Society for the Promotion of Engineering Education approve the formation of a

Division of Engineering Drawing with the following Executive Committee:

Thos. E. French, Chairman, R. P. Hoelscher, Secretary,
Clair V. Mann, W. G. Smith,
F. G. Higbee, H. H. Jordan,
H. M. McCully.

"2. That the Executive Committee of the Division appoint four committees to study and to report on the following subjects:

a. The objectives and scope of courses in Engineering Drawing.

b. The objectives and scope of courses in Descriptive Geometry.

c. Methods of stimulating research in and projects for research in Engineering Drawing and in allied subjects.

d. A summer school for teachers of Engineering Drawing and allied subjects.

"3. That the Executive Committee of the Division organize a conference for teachers of Engineering Drawing and allied subjects to be held in connection with the meeting of the Society for the Promotion of Engineering Education in 1929.

"4. That the Society for the Promotion of Engineering Education be requested to reserve in its budget funds to finance a summer school for teachers of engineering drawing and allied subjects in 1930 subject to the recommendations of the Division of Engineering Drawing."

Council approved the formation of the Division.

Council approved the officers named for one year.

Council referred items 2 and 3 to the Division of Engineering Drawing with power to act.

Council referred item 4 to the Board of Investigation and Coordination.

The Treasurer read the report of the auditor, which was accepted.

The Treasurer was given authority to investigate and invest the life membership fund as he sees fit.

The Secretary reported that $5,000 of the gift of Mr. Lamme for a medal had been placed in a trust fund in the Forbes National Bank of Pittsburgh, Pa., the remainder, $499.70, being placed in a checking account to cover the cost of medals.

The report of the Secretary was read by title and ordered printed in the JOURNAL.

The Council pledged cooperation in the formation of the World's Engineering Congress at Tokio, Japan, in October, 1929. Professor D. C. Jackson, Chairman, Charles F. Scott and W. E. Wickenden were appointed to represent this Society on this Congress.

The Council requested the Board of Investigation and Coordination to prepare a report for presentation at this Congress if such paper is acceptable to the Publication Committee of the Congress.

M. E. Cooley and H. S. Munroe, having retired from active work, were made life members of the Society.

The Secretary was instructed to write a letter to Dean Cooley expressing the appreciation of the Council and of the Society for the work which he has done for both.

H. J. Hughes was appointed on the committee of this Society on the American Council on Education. The other members are Hugh Miller and F. L. Bishop.

The report of the Committee on the Lamme Medal was presented and adopted. The committee was then discharged as their work was completed when the dies for the medal were cast.

The following budget for 1928–29 was approved:

Receipts:

Individual dues	$ 8,000.00
Institutional dues	1,770.00
Back dues	500.00
Advertising	2,000.00
Sale of publications	350.00
Estimated receipts	$12,620.00

Disbursements:

A. 1929 Meeting	$ 400	
B. Journal, Proceedings, and year book	6,000	
C. Committee expenses	150	
D. Secretary's honorarium	1,000	
E. Clerical assistance	3,000	
F. Sundry printing	300	
G. Postage	300	
H. Telegraph and telephone	50	
I. Supplies	50	
J. Traveling expenses	500	11,750.00
Estimated surplus		$ 870.00

The Committee on the Lamme Award presented the following operating technique which was adopted by the Council:

"The Committee suggests the following technique in the election of future recipients of the Lamme medal: (1) That each member of the S. P. E. E. be asked each year to suggest not more than two (2) names for consideration of the committee. (2) That the presidents of engineering colleges and technical schools be invited to make one recommendation from their particular school. (3) That to aid in the above canvass and the recording of information a suitable form be prepared upon which data substantiating the claim for recognition be recorded. (4) That it would be helpful if somewhere personnel records of teachers of engineering were maintained for consultation purposes, and suggests that the S. P. E. E. Board consider the advisability and method of establishing such service. (5) That after the names of the candidates are received by the chairman, the recommendations shall be made available to all members of the committee, and from then on the procedure be as follows:

"*a.* With the guidance of the list of those recommended each member of the Committee shall nominate not more than two (2) candidates, not necessarily from the list.

"*b.* The candidates receiving the two highest number of votes shall be eligible for a second ballot, and the record of their accomplishments made available in detail to the members of the committee.

"*c.* A secret ballot shall be taken in which each member of the Committee votes for but one man, and this ballot shall be opened in a meeting of the Committee in the presence of at least four (4) members.

"*d.* If on the opening of the secret ballot the Committee finds that one man has the majority of the votes cast, he shall be given the award. In case of the failure to attain a majority the members of the Committee present shall have the power to select the recipient from the candidates included in the secret ballot, taking into consideration the judgments of the absent members as expressed by their ballots.

"*e.* A report of the action of the Committee shall be made to the President of the Society, together with a statement of qualifications and the accomplishments of the proposed recipient.

"*f.* Suitable publicity shall be given in the public press by the Secretary of the Society."

The Committee on Policy made the following report:

"1. At the Council meeting of June 26, 1928, a report, dated June 22, 1928, of the special Committee on Institutional Membership was referred to the Committee on Policy. The Committee on Policy is of the opinion that at least for the present the general policy as set forth in the report of the Committee on Institutional Membership is wholly wise, namely, that there be admitted as new institutional members only degree-granting engineering schools of standards, resources, and stability comparable with those of the majority of the present institutional members.

"2. At a Council meeting in June, 1927, the Committee on Policy was requested to consider the desirability of the establishment of a Division of Non-Collegiate Technical and Trade Schools, and to report its recommendations to the Council in 1928. Likewise its recommendation as to whether the grade of institutional member should be extended to such schools and to public high schools.

"The Committee on Policy was requested to consider, recommend, and report to the Council in 1928 what kinds, types, and grades of colleges, institutes, and schools shall be elected as institutional members with possible proposals for changes in Article II of the Constitution.

"The Committee on Policy is of the opinion that the detailed study of these questions is within the province of, and can best be handled by, the Institutional Division of the Society, and recommends that that Division be requested to appoint a committee to report on the question of the desirability of extension of institutional membership under such groups as:

a. Degree-granting engineering schools of grade of present membership.
b. Non-degree-granting schools of intermediate grade.
c. Institutions not primarily engineering or technical schools but giving certain instruction in engineering.
d. Corporation training schools in technology.
e. Technical high schools.

and further to report on the standards to be applied to each group, if recommended.

"The Committee on Policy suggests that the study of the possible need of extending the range of institutional membership should be much aided by the study now being begun under the Board of Investigation and Coordination and the staff on non-collegiate technological education.

"3. In the opinion of the Committee it is clear that a stage of further development of the organization of the Society is approaching. In particular when the present Board of Investigation and Coordination, which was not constituted as, and has never contemplated itself as, a permanent arm of the Society, has completed its work, if the present efforts to find support for the continuation of the central activities of the Society and the maintenance of a staff are successful, it will be necessary to provide some directing board and to define and to correlate in terms of new conditions the activities and the responsibilities of the directing board and the staff and the officers of the Society.

"The Board of Investigation and Coordination has referred to the Committee on Policy a report of the Director of Investigation to the Board on "Future Organization and Activity," which in line with the recommendations of this committee as adopted in June, 1928, proposes in detail developments in activity and modifications of organization. In this suggestive and valuable report two features stand out, first the clearer separation and definition of the functions of the Institutional Division on the one hand, and the Institutional membership on the other hand; and second, the merging of the functions of the present Executive Committee of the Society and the function of the type performed by the present Board of Investigation and Coordination into the function of a single enlarged executive committee of the Society.

"On the subject of the first feature of this report the Committee on Policy recommends that every encouragement be given by the Council to the organization of the Institutional Division for the effective performance of its special functions in the Society.

"On the subject of the second feature of the report of the Director of Investigations, namely the suggested merging of the functions of the present Executive Committee and of the present Board of Investigation and Coordination into the functions of a single enlarged executive committee, the Committee on Policy is not prepared to recommend action at present, but does recommend that this question of the central organization and definition of functions be a subject of study through the next year by the Committee on Policy if continued. The Committee considers that such a study is of great importance in view of the fact that the present Board of Investigation and Coordination may have completed its work by the end of 1929.

"4. At a June, 1927, meeting of the Council, the Committee on Policy was asked to report in 1928 on the perpetuation of the Committee on Policy. It is the opinion of the Committee that the present conditions as to the development and organization of the Society and its undertakings clearly indicate that a Committee on Policy should be maintained.

"The Committee recommends that a Committee on Policy be appointed anew in such manner as the Council may decide."

Council approved items 1 and 2.

Council approved item 3 that we proceed with present organization.

Council approved item 4 and authorized the incoming President to appoint a Committee on Policy.

The following new members were elected:

THE UNIVERSITY OF FLORIDA, Gainesville, Fla. J. R. Benton, Dean.

BAITY, HERMAN G., Associate Professor of Sanitary and Municipal Engineering, University of North Carolina, Chapel Hill, N. C.

BARRON, ASA C., Instructor, Alabama Polytechnic Institute, Auburn, Ala.

BETTS, ROBERT A., Instructor in Electrical Engineering, Alabama Polytechnic Institute, Auburn, Ala.

BROWN, CHARLES C., Acting Associate Professor of Civil Engineering, University of Florida, Gainesville, Fla.

BUXTON, GEORGE F., Professor of Industrial Training, Purdue University, Lafayette, Ind.

CLAPP, JOHN M., Editor, Ronald Press Company; Lecturer, School of Retailing, New York University; 15 East 26th Street, New York City.

CONWELL, WALTER I., Professor of Civil Engineering, Cornell University, Ithaca, N. Y.

COYLE, JOHN L., Director, Shop Practice, University of Delaware, Newark, Del.

DOSTAL, BERNARD F., Assistant Professor of Mathematics, University of Florida, Gainesville, Fla.

ELIZONDO, YUDALECIO A., Instructor in Mechanical Engineering, Alabama Polytechnic Institute, Auburn, Ala.

ELLIOTT, EDWARD O., President Purdue University, Lafayette, Ind.

FENTON, FREDERICK C., Associate Professor of Agricultural Engineering, State University of Iowa, Iowa City, Iowa.

FIELDING, JOHN, Instructor in Mechanical Engineering, State University of Iowa, Iowa City, Iowa.

FOUSHEE, JOHN M., Instructor in Engineering, University of North Carolina, Chapel Hill, N. C.

FREEMAN, MATHEW L., Professor and Head, Department of Drawing, Mississippi A. & M. College, A. & M. College, Miss.

GLADNEY, THOMAS G., Professor of Civil Engineering, Mississippi, A. & M. College, A. & M. College, Miss.

HOADLEY, ANTHONY, Assistant Professor of Civil Engineering, Union College, Schenectady, N. Y.

KETCHUM, RICHARD B., Dean, Schools of Mines and Engineering, University of Utah, Salt Lake City.

KLOTZ, FREDERICK E., Instructor in Civil Engineering, Iowa State College, Ames, Iowa.

KREWATCH, ALBERT V., Instructor in Electrical Engineering, University of Delaware, Newark, Del.

LAWRENCE, JAMES C., Administrative Assistant to the President, University of Minnesota, Minneapolis, Minn.

MAYLOTT, CARLETON F., Instructor in Electrical Engineering, Lehigh University, Bethlehem, Pa.

NINDE, GEORGE F., Instructor in Engineering Drawing, Harvard Engineering School, Cambridge, Mass.

OGBURN, SIHON C., Professor of Chemical Engineering, Bucknell University, Lewisburg, Pa.

PUMPHREY, FRED H., Instructor in Electrical Engineering, State University of Iowa, Iowa City, Iowa.

SCHOMMER, JOHN J., Assistant Professor of Industrial Chemistry, Armour Institute of Technology, Chicago, Ill.

SELLMAN, HUNTON D., Instructor, Sacramento Junior College, Sacramento, Calif.

SMILEY, THOMAS B., Instructor in Electrical Engineering, University of North Carolina, Chapel Hill, N. C.

SPAHR, ROBERT H., Member of Staff, S. P. E. E., 33 West 39th Street, New York City.

STEMPEL, WALDEMAR M., Assistant Professor, Stevens Institute of Technology, Hoboken, N. J.

THOMAS, A. L., Professor of Engineering Drawing, Alabama Polytechnic Institute, Auburn, Ala.

SWENSON, GEORGE W., Professor of Electrical Engineering, Michigan College of Mines and Technology, Houghton, Mich.

WASHINGTON, LAWRENCE, Instructor in Mechanical Engineering, University of Minnesota, Minneapolis, Minn.

WEAVER, WILLIAM H., Instructor in Industrial Engineering, The Pennsylvania State College, State College, Pa.

WILBUR, WALTER E., Assistant Professor of Mathematics, University of New Hampshire, Durham, N. H.

WINFREY, ROBLEY, Assistant Director, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

WOOLEY, JOHN C., Professor of Agricultural Engineering, University of Missouri, Columbia, Mo.

Respectfully submitted,

F. L. Bishop,
Secretary.

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